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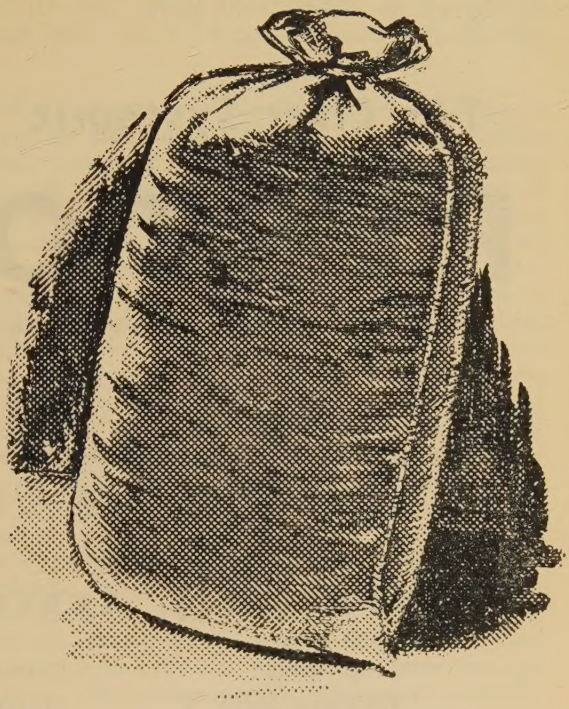

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JOHNSTON (H. B.) & BUXTON (D. R.). **Field Observations on Locusts in eastern Africa.**—*Anti-Locust Bull.* no. 5, 74 pp., 5 pls., 6 figs., 33 refs. London, 1949.

The observations described in this report were carried out by Johnston in 1932–36, largely in Uganda, and by Buxton in 1934–35, largely in Kenya. The following is based on their summary and conclusions. The primary objective of the investigations was to establish the presence or absence of outbreak areas of *Locusta migratoria migratorioides*, R. & F., in eastern Africa and to study the process of disintegration of swarms of this species and the transformation of its swarming phase into the harmless solitary one. Observations in Uganda by Johnston (pp. 8–34) on the habits of this locust in its swarming phase showed that bare ground or ground disturbed by cultivation is preferred for egg-laying, without special regard to the type of soil. The density of egg-packets in the soil in Uganda was less than in other countries. The number of eggs in a packet varied from 29 to 123. The incubation period of eggs in the field was 20–25 days at soil temperatures ranging from 65 to 97°F., and the period may be somewhat lengthened in very damp soil. Two broods of the swarming phase occur annually in Uganda, and they may partly overlap in the areas with more extended rainy periods. Farther north, in the Sudan north of the Sudd area, only one annual brood is possible owing to the shortness of the rainy period. Seasonal migrations of swarms in Uganda are much less regular than in drier countries, so that it is difficult to correlate their movements with seasonal changes in weather. A noticeable feature of breeding in Uganda from 1933 onwards was the constantly diminishing size of the hopper bands and their eventual scattering, with a reversal of phase *gregaria* through phase *dissocians* to phase *solitaria*. The causes of this process are probably complex and not uniform in the different areas. The factors concerned may be of two kinds. The first factor is physiological and connected with the observed uneven development of eggs in all females of a laying swarm. Consequently, eggs are not deposited all at once or in one place, but in smaller batches in many localities along the route of the swarm. The result is the appearance of relatively small and widely scattered hopper bands, instead of the large and compact bands that are produced in the areas like the central and northern Sudan, where the breeding season is short, but very favourable, and females mature and deposit their eggs more or less simultaneously and in concentration. Other factors are environmental in character and affect hopper bands. Wandering bands of the gregarious phase coming into dense vegetation, such as stands of *Cynodon* grass, tend to become immobilised and scattered. Direct observations on the changes in the coloration of hoppers thus caught by *Cynodon* stands and biometric studies of the resulting adults proved that a transformation in the direction of phase *solitaria* may be the result. Locusts of the solitary phase, produced in this way, were not ubiquitous in Uganda, but occurred mostly in certain types of short grass. Observations on their survival in such situations did not extend long enough to show whether they can live permanently in Uganda.

A survey of some localities in Kenya, suspected as suitable for a permanent survival of *L. m. migratorioides* in the solitary phase, was made by Buxton (pp. 34–51), and in three of them (Lake Rudolph, Lake Baringo and the southern Uaso Nyiro), populations of this locust possessing the characteristics of phase *solitaria* and some degree of permanence were found among short grass vegetation subject to occasional flooding or rainfall, in areas with a generally hot and arid climate. These East African habitats of the phase *solitaria* are characterised by altitudes not exceeding 3,500 ft., level ground subject to occasional brief flooding, but not to long continued flooding, which is unfavourable, a covering of short grass with bare spaces or of tufted grasses

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which, however, should be dense enough to provide shelter with a relative humidity of over 50 per cent., and an annual rainfall of less than 35 inches. Comparative biometrical studies on populations from several habitats suggest that the approach to the pure phase *solitaria* was greater in those more favourable to the species, with abundant food and suitable climate, than in the less favourable habitats. From a consideration of whether these populations of solitary locusts could ever give rise to swarms, it was concluded that although transformation to phase *gregaria* is not impossible, it is extremely unlikely to occur and then only in very few places and on a small scale. Therefore, the formation of swarms in eastern Africa is not to be anticipated. It would, however, be a wise precaution if the three areas specified were inspected from time to time, to ascertain the status of their populations of solitary locusts. A special case was the temporary occurrence of solitary locusts in two semi-desert localities of the Turkana province in Kenya. The locusts appeared in both cases after heavy flooding, and it was suggested that they may have hatched from eggs that had survived in the ground for about two years.

Certain areas of northern Turkana in Kenya, which were under suspicion as possible habitats of *Schistocerca gregaria*, Forsk., in the solitary phase, were investigated by Buxton (pp. 51–53). The conclusion reached was that this locust is very rare there and that local conditions give no reason for regarding Turkana as a possible outbreak area. Since no investigations on locusts had ever been made in Somalia, a preliminary survey of the southern part of that country was carried out, but no examples of *S. gregaria* were found. A comparison of the natural conditions of Somalia with those of the known outbreak areas on the Red Sea coast of the Sudan showed that southern Somalia is unsuitable for the solitary phase of *S. gregaria*. Certain coastal areas of Kenya investigated at the same time proved similar in character and also harboured no locusts.

Some observations on *Nomadacris septemfasciata*, Serv., were made in Uganda by Johnston (pp. 53–68) during 1933–36. Infestation of Uganda by this locust began in 1933 in a very small area in the south-west of the country and was due to an invasion from outside [*cf.* *R.A.E.*, A **22** 702; **23** 10]. Later, swarms spread gradually over most of the country, taking four breeding periods to complete the occupation. Although adults kept in cages showed some signs of sexual maturation without passing through a long diapause, they did not oviposit. In the field, the species remained strictly single-brooded in spite of the prolonged rainy period. This was probably due to the temperature remaining too low for sexual maturation. Isolated adults with the characteristics of phase *gregaria* were sometimes found in places remote from swarms. The supposition that these arose on the spot is unlikely and it is suggested that small portions of swarms, or even individual locusts, may undertake long flights. An examination of old records, prior to 1933, suggested that no outbreak centres of *N. septemfasciata* exist in Uganda.

Observations on *N. septemfasciata* in Kenya in 1935 are recorded by Buxton (pp. 68–70). Two colonies were found, both in the Eastern Rift Valley. The characters of the locusts in both were those of phase *solitaria*. Although the possibility that they originated from swarms cannot be excluded, it appears more probable that they represented local populations. The conditions of their habitats were such that they cannot be considered as likely outbreak centres.

The investigations carried out in Uganda, Kenya and southern Somalia supplied reliable evidence in favour of the view that these countries do not harbour outbreak centres of any of the three locusts that are known to invade eastern Africa. On the other hand, coupled with the results of investigations in other parts of the continent, they leave no doubt that eastern Africa will continue to be subject to locust invasion from outside, unless measures are

taken to prevent swarms arising in the outbreak areas. Such measures are to be regarded as essential for the protection of the planned development of eastern Africa.

A note on the native names of the three species in Uganda is given by Johnston (pp. 70–71).

International Convention for the permanent Control of Outbreak Areas of the Red Locust. London, 22nd February, 1949. [*In English and French.*]—*Treaty Series* no. 53 (1949) (Cmd. 7783) 9 pp. London, H.M. Stationery Office, 1949. Price 4*d*.

This convention, which was signed by representatives of the governments of Belgium, the United Kingdom, the Union of South Africa and Southern Rhodesia, provides for the establishment at Abercorn, Northern Rhodesia, of an International Council for the Control of the Red Locust [*Nomadacris septemfasciata*, Serv.] composed of representatives of the governments of the Union of South Africa, Kenya, Uganda, Tanganyika, Nyasaland, Northern Rhodesia, the British High Commission Territories in South Africa (Basutoland, Bechuanaland Protectorate and Swaziland), the Belgian Congo and Ruanda Urundi, and Southern Rhodesia. An International Service for the Control of the Red Locust is to be set up by the Council to organise permanent control of the known outbreak areas, investigate suspected ones, take steps for the immediate destruction of incipient swarms in the outbreak areas, organise an information service on the movements and breeding of swarms outside the outbreak areas, study the habits and ecology of *N. septemfasciata* and methods for its control, and issue periodical progress reports. The Council may at any time agree to the extension by a signatory government of the convention to other parts of its territories, and may invite governments other than the signatories to accede to it. It is to be ratified by the signatory governments and is to come into force on the receipt by the government of the United Kingdom of the second instrument of ratification. It is to remain in force for ten years, after which any contracting government may denounce it or make notification that it shall cease to apply to any of its territories, and such procedure is to take effect after one year. The Convention was ratified by the government of the United Kingdom on 14th April 1949.

COATON (M. G. H.). **The Harvester-termite Problem in South Africa.**—*Bull. Dep. Agric. S. Afr.* no. 292, 38 pp., 1 pl., 17 figs., 5 refs. Pretoria, ?1947.

Investigations have been in progress in South Africa since 1936 to develop control measures for use against harvester termites (species of *Hodotermes*), which are chiefly of importance as agents causing soil erosion in the veldt [*R.A.E.*, A **23** 377, 675], and the first part of this bulletin is mainly devoted to an account of work on their nesting and feeding habits. These termites are distributed throughout South Africa except in very mountainous areas and regions of high rainfall, and 16 species are indigenous in the Union and South-west Africa. The investigations were performed on *H. mossambicus transvaalensis*, Fuller, which is typical of the group, and the control measures evolved were found to be applicable to others.

With the exception of *H. thomseni*, Fuller, these termites do not construct mounds. The site of a colony is indicated by the presence of harvesting holes, which are the entrances to subterranean passages through which grass is taken into the nest, and of soil dumps ; the exact position of the main nest is difficult to discover, but the nest system includes breeding centres and also temporary storage chambers that evidently come into use seasonally as the supply of

grass varies. Surface activity takes place only at widely separated intervals during late summer, autumn and early winter, when grass is normally abundant in the Orange Free State and Transvaal and the storage chambers can be well stocked, but can be observed almost daily in late winter and spring and during dry summers, when grass is scarce. It does not occur at very low or very high temperatures or during or immediately after rain. The rate of denudation by a single colony was studied on an area containing an isolated nest, over which was a patch of stubble that was separated from dense grass by a narrow belt of sparse grass. In May 1937, the stubble occupied an area of 25 sq. yards, the workings were contained in an area of less than 400 sq. yards, and 294 harvesting holes were in use. By September, the central stubble area had increased to 491 sq. yards, the workings extended over more than 3,600 sq. yards, and there were over 552 holes. In May 1938, when grass was again plentiful, the central area occupied only about 28 sq. yards, and there were only 193 holes. Over most of the district, the colonies were so close that the denuded areas merged, and in July 1938 the number of harvesting holes in such an area averaged 1·26 per sq. yard. Under these conditions, the grass is completely destroyed if the spring and summer rains are delayed. The chief natural enemy is the antbear (*Orycteropus afer*), which attacks the termites below ground, but appears to prey more frequently on termites of other groups. Above ground, harvester termites are attacked by insectivorous birds, toads, lizards and the red meerkat [*Suricata*]; an examination of the stomach contents of a series of the last showed that 50–95 per cent. comprised the remains of harvester termites. All these animals are decreasing, either by direct destruction or by being exposed to natural enemies as a result of the overgrazing that has followed a general reduction in the size of farms. Overgrazing during winter and, more especially, spring, evidently favours the establishment of colonies, since it was observed in 1937 that only two new ones were founded in an area with a dense grass cover at the time of swarming, whereas 23 were established in a similar one that was bare at that time.

Harvester termites also cause heavy losses among growing crops of wheat, rye, oats, beans, lucerne and teff [*Poa abyssinica*] throughout the Union. Damage is greatest in the arid region, but also occurs in irrigated lands on newly ploughed veldt, though flooding reduces the population after a season or two. Buildings constructed of sun-baked or raw bricks and their thatched roofs are sometimes severely damaged, as is lime mortar in any type of building, but such infestations are usually extensions of workings from nests outside them. Buildings of baked brick and cement mortar are not attacked.

Experiments on control are described and their results discussed in the second part of the bulletin. Poison bait was used, since removing the royal pair and the use of liquid fumigants and toxic smokes are all unsatisfactory. In an initial test, in which a handful of veldt grass that had been chopped into ½-in. lengths, dipped into a solution of 1 lb. sodium arsenite and 8 lb. sugar in 8 gals. water and dried was spread round each harvesting hole on a test area daily from April till July 1936 activity was reduced as compared with a control plot in May, had almost ceased by July, and was not renewed up to the end of December. Analyses in 1937 of dead termites and grass from the storage chambers of a nest from which all activity had ceased following the broadcast application of bait six weeks earlier proved that poisoned bait is taken below ground, stored, and ultimately consumed. Large-scale tests to determine practicable methods of application and effective dosages for use over large, heavily infested areas of grazing land were begun in July 1938. It was found that surface activity ceased within two months whether the bait was spread round the harvesting holes daily over a period of six weeks or broadcast over the area once or twice at an interval of one month. In addition, the surface activity of colonies on adjacent unbaited ground was very greatly

reduced. Equally good results were obtained when the sugar was omitted from the bait solution, and chaff can be substituted for grass.

A method for preparing large quantities of the bait, which should be done in an adequately fenced area, is described. The bait can be stored indefinitely. It should be prepared in late summer, when grass is plentiful, and applied towards mid-winter, when the termites are visible by day and forage over small areas. Areas baited during winter should not be grazed until after good rains have fallen. If it is necessary to bait areas on which stock is confined, sodium fluosilicate, which has given good results in the Transvaal but is less toxic to the termites, should be substituted for sodium arsenite. To reduce risk to stock if treated areas must be grazed during or soon after baiting, the grass employed should not exceed ½ in. in length, the bait should be applied dry to ensure an even spread, and baiting should be done before the veldt is completely denuded. If several areas are to be treated on one farm, this should be done over a period of years, so that stock need not be grazed on treated pasture until after summer rains have fallen. Cultivated crops can be completely protected by properly timed applications of bait, which are best made just before or at the time of sowing. Satisfactory results were obtained on newly-broken dry lands in the Orange Free State in 1946 by delaying the application until after germination and treating only the infested areas, which were apparent as bare patches, before any considerable damage was done. Infestation in buildings can be eradicated by applying the bait round them regularly whenever and wherever termites are seen foraging.

BUZACOTT (J. H.). **The Use of Benzene Hexachloride in North Queensland Canefields.**—*J. Aust. Inst. agric. Sci.* **14** no. 1 pp. 24–27, 2 figs. Sydney, 1948.

During investigations on soil treatment with a dust containing 10 per cent. crude BHC (benzene hexachloride, of which 13 per cent. was γ isomer) for the control of *Dermolepida albohirtum*, Waterh., in sugar-cane fields in North Queensland [*R.A.E.*, A **35** 367 ; **38** 89], it was found that though the BHC did not noticeably affect the development of shoots on setts to which it was directly applied, it inhibited the production of primary and secondary roots, even at comparatively low rates. As a result of contact with it, the roots terminate abruptly and show characteristically thickened, blunt ends. When the dust is mixed with the soil before planting, there is no noticeable retardation in growth until the rate of application exceeds 40 lb. crude BHC per acre and when it is applied to the surface of the soil some time after planting and subsequently worked in, rates of up to 60 lb. can be safely used ; a rate of 10 lb. per acre is probably sufficient to give adequate control of the larvae. Tests in progress in which plants were treated with the pure α, β, γ, and δ isomers at rates of up to 40 lb. per acre and with S.G. 220 (a preparation that contains 20 per cent. γ isomer and is relatively free from the α and β isomers) have already shown that considerably heavier applications of γ BHC can be safely made when it is pure or in S.G. 220 than when it is in crude BHC. In a test in which it was applied to plants in pots at a rate of 13 lb. per acre as the pure isomer, as S.G. 220 and in crude BHC, only the last caused the root systems to become stunted.

In cage trials, γ isomer that had been incorporated in soil 15 months earlier was as effective against adults of *D. albohirtum* as freshly mixed material at a concentration of 10 parts per million, but caused mortality much more slowly at 1 p.p.m. The minimum concentration of the fresh isomer that is effective against the adults is about 0·5 p.p.m. There are indications that a comparatively light application in the year after treatment will restore toxicity to its original level. For the control of the larvae, there is good evidence

that a rate of only 75 lb. 10 per cent. crude BHC per acre may be effective in some cases and that one of 50 lb. may be of value on heavy soils. Dusting can be carried out at any time between August and November, but preferably at least a month before beetle flight [*cf.* **38** 89], and is best done before the field is worked level, so that the dust is concentrated near the base of the stools when infestation by larvae begins.

MUNGOMERY (R. W.). **The Use of Benzene Hexachloride in controlling " White Grubs " in Queensland Canefields.**—*Proc. 15th Conf. Qd Soc. Sug. Cane Technol.* 1948 pp. 35–42, 3 figs., 2 refs. Brisbane, 1948.

Much of the information in this account of work on soil treatment with dusts containing BHC (benzene hexachloride) for the control of *Dermolepida albohirtum*, Waterh., in sugar-cane fields in Queensland has already been noticed [*R.A.E.*, A **35** 367; **38** 89]. In the trials during 1946–47, the yield of cane from uninfested plots treated with 10 per cent. crude BHC (13 per cent. γ isomer) at rates of 100, 150 and 200 lb. per acre was not adversely affected as a result of the treatment, and the production of shoots by setts in fields over which 10 per cent. BHC was broadcast at a rate of 150 lb. and subsequently worked in was not impaired. The growth of leguminous plants, which are often used as green manure crops, was unaffected by rates of up to 1,000 lb. dust per acre. Good control of the larvae was given by a rate of 100 lb. [**38** 89].

When the 10 per cent. dust was applied to the cane rows at rates exceeding 200 lb. per acre, it caused a marked reduction in the numbers of larvae of *Lepidiota consobrina*, Gir., and at 100 lb. per acre afforded some protection against larvae of both this species and *L. frenchi*, Blkb., possibly by immobilising the older individuals. Sugar cane in a plot that was fairly heavily infested by larvae of *Pseudholophylla furfuracea*, Burm., in March 1947 and was treated with the BHC dust at 50–200 lb. per acre a few weeks later was in better condition than that in untreated rows by the following October. Applications of the dust at rates of up to 400 lb. per acre made in March to furrows at the side of rows of ratoon cane in soil heavily infested by larvae of *L. trichosterna*, Lea, were of no value against the third-instar larvae inside the underground portions of the stools.

SPILLER (D.). **Toxicity of some metallic Sulphates to the Common House Borer** *Anobium punctatum* **De Geer.**—*N.Z. J. Sci. Tech.* **30** (B) no. 1 pp. 20–21. Wellington, N.Z., 1949.

A technique developed in New Zealand for evaluating the toxicity of timber preservatives to *Anobium punctatum*, Deg., is briefly described. One-inch cubes of wood, are impregnated with the preservative, under conditions that ensure complete penetration and even distribution, and are then air dried and transferred to the testing room for storage. When testing begins, each cube is exposed to sufficient beetles to ensure the deposition of over 150 eggs on it and is then stored for nine months under conditions favourable for the development of *Anobium* (22·5°C. [72·5°F.] and 85 per cent. relative humidity) and examined for the presence of larvae. The amount of preservative in the block, calculated from the weight of solution absorbed and its concentration is expressed as a percentage of the calculated oven-dry weight of the blocks and termed the " loading." Materials that give complete protection at or below loadings of 1 and 0·25 per cent. can be regarded as reasonably and highly toxic, respectively, and those that permit larvae to survive at a loading of 2 per cent. as non-toxic.

Since heavy loadings of cheap materials may be more economic than lighter loadings of dearer ones, it was decided to investigate some of the former, and

the method was used for preliminary tests with ferrous sulphate and the sulphates of sodium, aluminium, magnesium and manganese, using the sapwood of *Podocarpus dacrydioides*. The sulphates of sodium and magnesium both permitted survival at a loading of 2 per cent., and since none of the others was toxic at 0·25 per cent., it is concluded that they do not warrant further consideration.

SPILLER (D.). **Toxicity of Boric Acid to the Common House Borer** *Anobium punctatum* **De Geer.**—*N.Z. J. Sci. Tech.* **30** (B) no. 1 pp. 22–23, 3 refs. Wellington, N.Z., 1949.

In view of the effectiveness of boron compounds in protecting hardwood timber from attack by *Lyctus* (*R.A.E.*, A **24** 373; **27** 509], the toxicity of boric acid to larvae of *Anobium punctatum*, Deg., was tested in New Zealand in 1945–47 by a method already described [see preceding abstract]. Cubes of sapwood of *Podocarpus dacrydioides* and *Pinus radiata* were used. Loadings of 0·022 per cent. and lower did not prevent the development of the larvae, but those of 0·043 per cent. and above gave complete mortality.

JACKS (H.) & COTTIER (W.). **Cecidomyid Midges on Meadow Foxtail and Cocksfoot in New Zealand.**—*N.Z. J. Sci. Tech.* **30** (A) no. 1 pp. 9–12, 6 refs. Wellington, N.Z., 1949.

The Cecidomyiid that infests the seed-heads of meadow foxtail (*Alopecurus pratensis*) in New Zealand was generally thought to be *Dasyneura alopecuri*, Reut. [*cf. R.A.E.*, A **5** 165; **6** 535; **24** 796], a statement by Barnes in a paper already noticed [**19** 535] that the New York State Museum contained specimens of *Stenodiplosis geniculati*, Reut., reared from that grass in New Zealand not having been appreciated. A survey in 1938–39 confirmed the presence of *S. geniculati* in *A. pratensis* in New Zealand [**28** 536]. It was continued in 1939–40 and extended to include cocksfoot (*Dactylis glomerata*), since a Cecidomyiid breeding in that grass in 1937–38 was described by Barnes as *S. geniculati* var. *dactylidis* [**28** 536]. Seed-heads of *Alopecurus* and *Dactylis* were collected from many districts between November 1939 and March 1940, and the Cecidomyiids that emerged from samples of each lot kept in the laboratory for 60 days were counted and removed daily. All those obtained from *Alopecurus* were *S. geniculati* and all those from *Dactylis* were *S. geniculati* var. *dactylidis*, for which colour descriptions of the living adults of both sexes are given. Cecidomyiids emerged from both grasses from every locality sampled, but more were obtained per seed-head from samples from the North Island than from the South. In general, emergence from *Alopecurus* from the North and South Islands reached its maximum in November and December, respectively. Emergence from *Dactylis* from the North Island decreased after December, except in samples from one place, in which a maximum was not reached until February. Earlier investigators stated that Cecidomyiid infestation reduced the yield of foxtail seed by as much as 70 per cent. [*cf.* **6** 535], and as the number of midges obtained per seed-head in the samples was usually higher in cocksfoot than in foxtail, infestation of cocksfoot is likely to be as injurious. No examples of *Dasyneura alopecuri* were reared, and, if this species is present, it is evidently single brooded. No Cecidomyiids were obtained from seed-heads of oats, wheat and 13 other grasses.

HARRISON (R. A.). **Tests with D.D.T. and Gammexane on the Larvae of a Dermestid Beetle** (*Attagenus* **sp.), a Pest in some New Zealand Woollen Mills.**—*N.Z. J. Sci. Tech.* **30** (A) no. 2 pp. 100–104, 1 ref. Wellington, N.Z., 1949.

Larvae of *Attagenus* sp. cause considerable damage to cops of spun yarn in store in some wool mills in New Zealand by eating through to the centre, thus

weakening or breaking the thread in many places. The value of DDT (99–100 per cent. p,p′isomer) and BHC (crude benzene hexachloride containing 13 per cent. γ isomer) in protecting the scoured wool was therefore tested in small-scale experiments in which batches of 20 larvae of uniform size were introduced into petri dishes containing 0·6 gm. samples from treated wool. Scoured wool impregnated with 2, 5 and 10 per cent. of its weight of DDT in acetone solution caused 28·1, 29·2 and 38·3 per cent. mortality, respectively, after exposure for 18 days, and 58·2, 81·7 and 82·5 per cent., respectively, after 35 days, as compared with 1·8 and 6·9 per cent. for treatment with acetone only. Similar treatment with crude BHC to give 5 per cent. γ isomer by weight of wool caused complete mortality of larvae within 18 days Part of the mortality caused by the BHC may have been due to fumigant action, however, and since it stained the wool a dull red colour, it was not tested further. In all these tests, the solution tended to concentrate in the denser parts of the treated wool mass and to drain to the bottom as evaporation proceeded. Attempts to overcome this difficulty by teasing out the wool were only partially successful, and the wool samples probably contained less than the intended amount of insecticide.

In further tests, neatsfoot oil, which is one of the common batching oils used in mills in New Zealand, was the solvent for DDT. An emulsified saturated solution was heated to 120°F. and atomised on to the wool to give 0·57 per cent. DDT by weight. After drying for several days, the wool was exposed as before. It gave an average mortality of 75·2 per cent. in 17 days in one test and 72·5 per cent. in 14 days in another ; neatsfoot oil alone caused 5 per cent. mortality in the second test. The action of DDT was more rapid in the oil than in the acetone, evidently because it is deposited from the latter as coarse crystalline masses, whereas the oil does not volatilise to any extent after the water has evaporated and the larvae become coated with a solution of DDT that is readily absorbed through the cuticle. Continued contact with DDT appears to be necessary for satisfactory results, since when the larvae that had survived exposure to wool treated with the DDT emulsion for 14 days were transferred to untreated wool, only 18·2 per cent. (5 per cent. of the original total) died in a week and over 50 per cent. were alive 5½ months later and subsequently completed their development. It is concluded that treatment with DDT in emulsified neatsfoot oil shows promise as a means of control.

DELATTRE (R.). **Insectes du cotonnier nouveaux ou peu connus en Côte d'Ivoire.**—*Cot. et Fibr. trop.* **2** fasc. 1 pp. 28–33, 2 figs., 21 refs. Paris, 1947.

The author records the presence on cotton in the Ivory Coast of *Platyedra gossypiella*, Saund. [*cf. R.A.E.*, A **34** 96] and *Bemisia tabaci*, Gennadius, and gives notes on Mirids that attack cotton there. A species of *Helopeltis* was first found on cotton at Bouaké in 1939–40 and was thought to have been introduced on pigeon peas (*Cajanus cajan*), but it was found on indigenous plants from Bouaké in 1942 and it is probable that it has been present for many years, but unrecognised because it causes damage similar to that due to *Pseudomonas malvacearum*. It occurs in both the orange and red forms, and the author refers to it as *H. bergrothi*, Reut., though he points out that it is identical with the species called *H. sanguineus*, Popp., by Golding in Nigeria [*cf.* **33** 383, etc.]. Towards the south, it occurs wherever cotton is grown near the forest, but it does not reach so far north as the border with the French Sudan. It is a forest insect, requiring high humidity, and in the central area it occurs in the cotton fields only during the height of the wet season (September–October). The adults migrate with the wind and appear on cotton about the middle of September. Eggs are laid in plants chosen at random, and the

nymphs feed on these and neighbouring plants, so that infestation is patchy. If atmospheric conditions are favourable, the adults that develop from these nymphs oviposit on plants of favoured species and varieties of cotton, and nymphs of the second generation begin to feed on cotton two months after the first migration. When the rainy season is short, the second generation is much less abundant, because the dryness of the air and food results in high nymphal mortality and the adults oviposit less readily in the woodier stems and tend to migrate to damper places, where they pass the dry season. Reproduction begins with the first rains, and from the end of March some nymphs were found among the adults on different food-plants, such as rice and jute, near the river at Bouaké. The damage caused by *Helopeltis* varies considerably in different years and was severe in 1943. Plants grown in soil rich in phosphorus and potassium show some resistance to it. No parasite of *Helopeltis* has been found, but Reduviids and spiders may destroy small numbers of the bugs.

Two species of *Lygus* were found on cotton at Bouaké, a brown one similar to *L. vosseleri*, Popp., and a green one similar to a species that Taylor reported from Uganda in 1945 [and later described as *L. virens* (*cf.* **34** 13 ; **36** 26)]. *Lygus* infestations were much heavier and more prolonged in 1946 than in 1945. The outbreak began in the first week of October, and adults were numerous until 20th October, after which their numbers declined rapidly and the first invasion was virtually over. This consisted almost entirely of green *Lygus*, though a few of the brown species were present. No nymphs were found among the terminal leaves. From 10th November, numerous nymphs were found attacking the squares, and half the squares and young bolls were destroyed during the second half of November. All the nymphs collected gave rise to the brown *Lygus*, and all the adults collected at that time were of this species. It is therefore evident that adults of the green species attack the leaf-buds and squares in October and that infestation by the brown one is quite distinct, the migrating adults reproducing on cotton in November and giving rise to nymphs that feed on it until December, attacking chiefly the young squares and bolls. In 1946, approximately a third of all the squares and nearly half the bolls were shed, and cage experiments showed that most of this loss was caused by *Lygus*. It is preyed upon by various Hemiptera that appear on cotton with it, including species of *Geocoris*, *Orius* (*Triphleps*) and *Deraeocoris*.

Other Mirids, notably *Creontiades pallidus*, Ramb., cause shedding of the squares on a smaller scale, and an undetermined Mirid causes a type of injury intermediate between those due to *Helopeltis* and to *Lygus*.

JANNONE (G.). **Contributi alla sperimentazione sulla lotta antiacridica in Eritrea dal 1942 al 1946. I. Nuovo impiego di lanciafiamme sistemati su automezzi veloci.** [Contributions to Experiments on Locust Control in Eritrea from 1942 to 1946. I. A new Use of Flame-throwers mounted on fast Transport.]—*Risvegl. agric.* 1947 nos. 9–10, 15–16 repr. 8 pp., 8 figs. Taranto, 1947.

The author describes an improved type of flame-thrower that was developed in Eritrea in 1939 for use against locusts and discusses its advantages and disadvantages. It was adapted for mounting in pairs on jeeps and light armoured cars (Bren gun carriers) and proved efficient in operation against *Schistocerca gregaria*, Forsk., in 1944–45.

ALKAN (B.). **Diyarbakır, Elâzığ, Tunceli ve Malatya'nın önemli tarım zararlıları.** [Important Pests of Agriculture in Diyarbakir, Elâziğ, Tunceli and Malatya.]—*Ziraat Dergisi* **8** no. 87 pp. 7–18. Ankara, 1947.

An annotated list is given of the animal pests, mostly insects, that injure crops in south-eastern Turkey, based on surveys carried out in several

localities in recent years. The most important crop in the area is wheat. Apart from numerous locusts and grasshoppers, it is attacked by *Eurygaster integriceps*, Put., and *Aelia rostrata*, Boh., which cause severe damage, *Margarodes tritici*, Bodenh. [*cf.* *R.A.E.*, A **34** 256] and species of *Anisoplia*, *Zabrus* and *Agrotis*. Pests of fruit trees include *Cydia* (*Carpocapsa*) *pomonella*, L., *Hyponomeuta padellus malinellus*, Zell., and *Eriosoma lanigerum*, Hsm., on apple, *Zeuzera pyrina*, L., on apple, olive and other trees, *Anthonomus pomorum*, L. (which apparently does not attack apple in Turkey) and *Eriophyes pyri*, Pgst., on pear, *Eulecanium* (*Sphaerolecanium*) *prunastri*, Boy., *Capnodis* spp., *Labidostomis propinqua*. Fald., *Anarsia lineatella*, Zell., and *Ceratitis capitata*, Wied., on stone fruits, *Cimbex quadrimaculata*, Müll., *Eurytoma amygdali*, End., and *Aporia crataegi*, L., on almond, and *Rhynchites* spp. on various pip and stone fruits. Grape vines were injured by *Polychrosis botrana*, Schiff., *Pulvinaria betulae*, L., *Omophlus* sp. and *Eriophyes vitis*, Pgst., cotton by *Earias insulana*, Boisd., melons by *Myiopardalis pardalina*, Big., and various crops, including vegetables and tobacco, by *Gryllotalpa gryllotalpa*, L. (*vulgaris*, Latr.). Very brief notes are given on the appearance and in a few cases the habits and importance of these pests.

İLERİ (M.). **Tütün tripsinin yaşayışı, salgınlaşması ve önlenme çareleri.** [The Bionomics, Mode of Infestation and Control of the Tobacco Thrips.]—*Ziraat Dergisi* **8** no. 87 pp. 19–57, 13 figs., 19 refs. Ankara, 1947.

Thrips tabaci, Lind., has caused such serious damage to tobacco in Turkey that a temporary field station was opened at Akhisar in February 1947 to investigate its life-history and control. This report contains an account of the work done during the first season.

The thrips was found to occur in two forms, a brownish one that occurred on onions and other plants, but not on tobacco, and a yellow one that was found mainly on tobacco. All stages of the tobacco form are briefly described. No sign of it could be seen before the planting of tobacco, though the other form was numerous on various plants and evidently continued its development during the winter, and it first appeared in the plant beds and newly planted tobacco fields at the end of March. Most of the fields examined had been under tobacco in the previous year or bordered those that had. The tobacco form appeared on onions and other vegetables soon after. There was no evidence of migration from other plants to tobacco.

Life-history studies showed that the adults survived for up to 15 days and the females laid up to 45 eggs each. The nymphs hatched in 5–6 days and left the plants to pupate in the soil after about six days. The prepupal and pupal stages lasted about one and 3–4 days, respectively. The thrips were not favoured by high temperatures, and injury usually ceased during hot weather. The optimum appeared to be about 30°C. [86°F.] for adults and 25°C. [77°F.] for pupae ; larvae were tolerant of a wide range of temperature and were the least sensitive of all the stages. Low relative humidity was unfavourable, especially to the eggs.

The chief preventive measure is considered to be clean cultivation. New plant beds should not be established on or near the sites of old ones, plant remains should be destroyed, and the fields should be ploughed immediately the crop is over. Various proprietary insecticides and nicotine sulphate were tested against the thrips in laboratory and small-scale field experiments. The only ones found effective were dusts and sprays containing DDT, which gave high mortality and retained their effectiveness long enough to kill the larvae

hatching from eggs present at the time of treatment. Repeated applications of dusts are recommended, but the cost under Turkish conditions is high.

TRAPPMANN (W.). **Pflanzenschutz und Vorratsschutz. Band 1. Grundlagen der Pflanzenpathologie.** [The Protection of Plants and Stored Products. Vol. 1. The Bases of Plant Pathology.]—2nd edn revd., 9½×7 ins., xii+270 pp., 80 figs., many refs. Stuttgart, S. Hirzel Verlag, 1949. Price *DM.* 18.

This is the first volume of a revised and much enlarged edition of the author's earlier work on pest control [*R.A.E.*, A **15** 616]. It is largely devoted to an exposition of the general principles and scientific knowledge underlying modern methods of protecting plants and stored products from insect, fungous and other pests, and contains detailed accounts of the various environmental factors that affect plant growth, the types of injury caused by biotic agents, the groups of organisms responsible, the relation between plant and pest, the causes and course of outbreaks and the spread of pests and diseases. The history of the subject from ancient times is described, its dependence at various periods on the general conceptions of nature then held is discussed, and its status as a branch of natural science is reviewed.

BÖHM (H.). **Untersuchungen über Biologie und Bekämpfung des Pflaumenwicklers** (*Grapholita funebrana* **Tr.**). [Investigations on the Biology and Control of the Plum Tortricid.]—*Pflanzenschutzberichte* **2** pt. 1–2 pp. 1–15, 1 pl., 2 graphs, 7 refs. Vienna, 1948.

Cydia (*Grapholita*) *funebrana*, Treitschke, has recently caused increased losses of plums in eastern Austria, and observations on its bionomics and control were carried out in 1946 and 1947 near Vienna to work out methods that would be more effective than those previously recommended. It was found that the life-cycle and habits of the moth resembled those recorded from Switzerland and Germany [*cf. R.A.E.*, A **25** 539, 659]. There was one complete generation and a large partial second in the year, and the larvae developed in plums and damsons, and occasionally in apricots and peaches. A few larvae of the first generation and all those of the second hibernated. The adults from overwintered cocoons were present from early May until early June, and those of the summer generation, which were considerably more numerous, from early July till early August. Adult activity was checked by heavy or cold rains, but was not affected by light warm rain or light wind. The optimum temperature for oviposition, which ceased at 12°C. [52·6°F.], was 24–26°C. [75·2–78·8°F.]. The females laid 40–60 eggs each, and the egg stage lasted 9–15 days for the first generation and 6–8 for the second. The period during which the larvae crawled over the fruits before entering them varied from 3 to 12 hours.

In experiments on control by means of sprays, the percentage of fruits infested was considerably reduced in both years by a proprietary form of DDT (Gesarol) applied twice at an interval of about a fortnight against each generation, especially when a suitable wetter was included. Nicotine was less effective, and calcium arsenate little better than no treatment. The DDT spray is therefore recommended. It should be applied 10 and 22 days after the first moths emerge from overwintered cocoons and 7 and 23 days after emergence of the summer generation begins. If rain intervenes, the treatment should be repeated. In any case, the usual mechanical control measures, such as the collection of fallen fruits, should be continued.

SCHIMITSCHEK (E.). **Erfahrungen bei der Anwendung von Kalkarsenspritzbrühe zur Bekämpfung des achtzähnigen Fichtenborkenkäfers** (*Ips typographus*). [Experiences in the Use of Calcium Arsenate Sprays for the Control of *I. typographus*.]—*Pflanzenschutzberichte* **2** pt. 1–2 pp. 16–27. Vienna, 1948.

A serious outbreak of *Ips typographus*, L., on spruce in Upper and Lower Austria and Styria began in 1945 [*cf. R.A.E.*, A **38** 49]. An energetic control campaign was instituted in Lower Austria, and the outbreak there was arrested in 1947. Since the shortage of labour limited the use of mechanical methods, chemical measures were adopted to supplement them. The use of contact dusts to kill the beetles that emerge from the bark removed from felled trees is not economical of labour, and a stomach-poison spray that would penetrate the wood and render barking unnecessary was sought. The only stomach poison available was calcium arsenate, which Wellenstein had found effective [*cf.* **37** 66]. It was used at a concentration to give 5 per cent. arsenic pentoxide in the spray. and the latter was applied to the whole surface of infested felled trees, which have to be turned to permit complete coverage. It is emphasised that every infested tree must be felled and treated if the method is to prove effective. The spray can be used to kill the young beetles as they emerge through the bark, the older beetles as they enter the bark to breed and the larvae feeding in the cambial zone. Mortality of the larvae does not occur for 2–3 weeks after it is applied, owing to the time required for penetration. It can also be applied to trap logs. Its penetration is assisted by rain and high humidity, but it should be applied during dry weather. It was used on infested felled trees, and on trap logs, which were sprayed before and after infestation, and gave excellent results, hardly any new infestations of living trees occurring in districts in which no other control measures were employed. Weaker sprays proved ineffective.

The degree to which the spray penetrated was investigated by analysing the arsenic content of various layers from sprayed logs at different intervals after treatment. The amount of arsenic present varied considerably, but diminished with depth, until there was only a trace in the sapwood 5–20 mm. deep. The amount in the bast and bark together decreased with time (for periods of up to 64 days) but that in the bast alone increased ; this increase was greater in infested than in uninfested portions of the log. Beetles that had entered a sprayed trunk, young adults that had been killed during maturation feeding in the cambial zone of a trunk sprayed seven weeks previously and young adults that were killed while emerging from a trunk sprayed six days before were found on analysis to contain 0·013–0·016 per cent. of their weight of arsenic trioxide.

SCHWERDTFEGER (F.). **Freilanduntersuchungen zur chemischen Borkenkäferbekämpfung.** [Field Investigations on the chemical Control of Bark-beetles.]—*Forst u. Holz* **3** no. 3 pp. 19–23. Hanover, 1948.

Further tests on the use of sprays against *Ips typographus*, L., in spruce forests were carried out in the Harz region of Germany in 1947 [*cf. R.A.E.*, A **37** 66]. The sprays used were emulsions of E605f and Gesapon [emulsifiable concentrates containing parathion and DDT, respectively], suspensions of calcium arsenate, and solutions of a proprietary mixture of fluorine salts alone or with a colloidal sticker and of a proprietary preparation of a dinitro-o-cresol salt (Caden). In the first series of tests, felled infested trees were sprayed in early April, before the overwintered beetles had emerged from them.

The concentrations and rates of application differed, and the trees were not turned during the process. The results, which were estimated by removing samples of the bark shortly before spraying and two and five weeks after it, and examining them for egg galleries and living and dead stages of the beetle, were variable and not always closely related to the amount of insecticide applied, and there was some tendency for mortality to be lower on the lower surfaces of the trunks, which had not been directly sprayed, but in general, applications of E605f at 0·6 oz. or more per sq. yard of surface and calcium arsenate and Caden at about ten times this rate gave high mortalities. The other materials were less effective, but Gesapon was the only one for which mortality increased after two weeks. In no case were the results of spraying equal to those obtained by removing the bark from the logs over sheets and carefully burning it, but spraying required only half the time taken by removing and burning the bark.

In further tests, trap logs felled in April or May were sprayed to kill the beetles attracted to them. E605f again gave the best results. It caused a marked reduction in the infestation and in the progeny produced, but it was not clear whether the beetles were killed before they entered the logs or were repelled. In the latter case, treated logs would be less effective than untreated ones. The author concludes that the use of insecticides and barking each have advantages and disadvantages, and the decision which to apply should depend on circumstances and local conditions.

THALENHORST (W.). **Über die Ursachen der Entstehung von Neuinfektionen durch den Buchdrucker.** [On the Causes of the Origin of new Infestations by *Ips typographus*, L.]—*Forst u. Holz* **3** no. 3 pp. 23–25, 4 refs. Hanover, 1948.

In the course of investigations on the outbreak of *Ips typographus*, L., on spruce in the south of the Harz region of Germany, the author sought to determine the factors that lead to the formation of foci of infestation. His observations showed that the beetles prefer a temperature of about 25°C. [77°F.] when selecting sites for breeding [*cf. R.A.E.*, A **37** 67], and so occur most frequently in spring at the edges of stands open to the south-east, south or south-west, or on the north side of clearings and roads. With rising temperature the infestation penetrates daily further inside the stands as the optimum is reached further in and the open edges become too hot. Within the limited spaces, to which infestation is then confined, the beetles attack trees that exercise a special attraction for them. Apparently, the attraction proceeds from wounds, since felled trees and broken or otherwise injured standing trees seem to be particularly attractive. In the case of trap logs from which the branches have been removed, temperature may also be of some consequence, since such trunks are more exposed to the sun than those shaded by their branches. If the beetles are abundant after the trap logs have been infested to their maximum capacity, they infest the surrounding living trees. Laying out an insufficient number of trap logs is therefore harmful, as it leads to the formation of new foci of infestation. In no case should trap logs be scattered singly in a forest. The number required should be calculated [*cf.* **37** 66; **38** 88] and, for small foci of infestation, the logs should be placed in groups in as few sites as possible in order to limit the local distribution of the beetles. In large foci, in which individual centres of attraction lose their significance, the logs should be laid out in a narrow belt close to the infested area, so as to hinder the spread. Trees thrown down or broken by storms, or otherwise injured standing trees, should be promptly removed.

Sylvén (E.). **Undersökningar över gammaflyet,** *Phytometra gamma* **L.** [Investigations on *Autographa gamma*.]—*Medd. Växtskyddsanst.* no. 48, 42 pp., 12 figs., 23 refs. Stockholm, 1947. (With a Summary in English.)

A considerable outbreak of *Autographa* (*Phytometra*) *gamma*, L., occurred in southern Sweden in 1946. Since this Noctuid does not overwinter in Sweden or does so to only a very limited extent, the outbreak must have been due to immigrants from the south. Similar outbreaks were recorded at the same time in Finland [*R.A.E.*, A **38** 87] and Denmark, and data from Denmark supplied by P. Bovien are included [**37** 323]. It is not known whether the immigrant moths belonged to one or more generations, but the latter is the more probable. The larvae were numerous and injured various crops, especially flax and seed crops of red clover and beet. Adults emerged at the end of July and were abundant in early August, but their numbers diminished in late August and September. Some that emerged in the laboratory paired and oviposited after feeding on honey, but hardly any eggs were laid in the field and females that were dissected contained no mature eggs. The moths of the new generation apparently resumed migration, but a return movement to the south could not be confirmed.

The processes of pairing and oviposition are described, and laboratory observations on the larvae are recorded, including studies of the amount of food consumed. Only two parasitised pupae were found among about a thousand examined. The parasite responsible was *Ichneumon* (*Stenichneumon*) *culpator*, Schr., var. *adsentator*, Tischb., a form of the species that had not previously been known from northern Europe. Some larvae and pupae were killed by disease. In experiments on the control of the larvae, proprietary dusts and sprays of DDT and a combined dust of DDT and benzene hexachloride gave very good results, a cryolite dust was less effective and dusts and sprays of zinc arsenate were little better than no treatment.

Tiensuu (L.). **Eräs tuholaisten joukkoesiintyminen varastoidussa maississa.** [Mass Occurrence of Insects in stored Maize.]—*Ann. ent. fenn.* **13** (1947) no. 4 pp. 153–170, 3 figs., 14 refs. Helsinki, 1948. (With a Summary in German.)

A cargo of maize received in Helsinki from Brazil in the autumn of 1946 was found to be heavily infested by insects, of which *Tribolium castaneum*, Hbst., *Calandra oryzae*, L. (*zea-mais*, Motsch.) and *Sitotroga cerealella*, Ol., occurred in millions, *Tenebroides mauritanicus*, L., *Gnathocerus maxillosus*, F., *Plodia interpunctella*, Hb., and *Ephestia cautella*, Wlk., were less abundant, and *Laemophloeus minutus*, Ol., *Sitophagus hololeptoides*, Lap., *Dermestes peruvianus*, Lap., *Tenebroides* sp. and a Chalcid were rare. Infestation had apparently arisen at the port of lading (Santos). The maize was stored on the premises of a centrally heated syrup factory, and though ventilators and windows were kept open, the temperature in February was about 9·5°C. [49·1°F.] in the storage quarters, 22–24°C. [71·6–75·2°F.] in the heaps of maize at a depth of 4 ins. and 31–32°C. [87·8–89·6°F.] at a depth of 12 ins. Temporary reduction in temperature was obtained by occasionally turning the maize with shovels. Fumigation with trichlorethylene killed the insects that occurred on the surface but had little or no effect on those inside the heaps. By April 1947, the loss of weight of the grain averaged over 15 per cent., and the contamination with excreta and larval and pupal skins decreased the value of the remainder.

The infestation was considerably increased by the inadequate conditions of storage and the favourable temperature at certain depths in the heaps. Experiments on the reaction of some of the species to steadily increasing heat showed that the temperature at which death occurred varied from 46 to 54°C.

[114·8–129·2°F.], the adults of *L. minutus* and the larvae and adults of *T. mauritanicus* being the most resistant. The temperature below which activity ceased varied from 3 to 12°C. [37·4–53·6°F.].

Estación de Fitopatología agrícola de La Coruña. Memoria 1943–1944. [The Phytopathological Station of Corunna. Report for 1943 and 1944.]—*Publ. Estac. Fitopat. agríc. La Coruña* no. 39, 76 pp., 41 figs. Corunna, 1947.

This report contains a section on the laboratory rearing of *Trichogramma minutum*, Ril., and *T. pretiosum*, Ril., in north-western Spain and the use of the former against *Gnorimoschema* (*Phthorimaea*) *operculella*, Zell., on stored potatoes that is almost identical with a paper already noticed [*R.A.E.*, A **35** 152], with the addition of rearing data for 1943.

In the summer of 1943, *Icerya purchasi*, Mask., was observed to have dispersed in large numbers from its normal food-plants (*Citrus* and *Pittosporum*) to others, including peach, cherry and grape vine. This occurred at a place where *Rodolia* (*Novius*) *cardinalis*, Muls., had recently been released against it, and the latter soon controlled it on all plants. Other injurious insects recorded include *Chrysomphalus dictyospermi*, Morg., on orange, *Epidiaspis* (*Diaspis*) *leperii*, Sign., which was repeatedly found on moribund pear trees, but was apparently not responsible for their condition, *Oxythyrea funesta*, Poda, which sometimes, together with *Epicometis hirta*, Poda, injured the flowers of rye [*cf.* **31** 121], *Cassida viridis*, L., on globe artichoke [*Cynara scolymus*], *Bruchus pisorum*, L., on peas, and the potato beetle, *Leptinotarsa decemlineata*, Say, which spread to Galicia in 1943 and within it in 1944 [*cf.* **36** 196, etc.].

Hammer (O.) & Karmo (E.). **Studier over de kemiske Plantebeskyttelsesmidlers Giftighed overfor Honningbier.** [Studies on the poisonous Effect on Honey Bees of the Chemicals used for Protection of Plants.]—*Tidsskr. Planteavl* **51** pp. 247–309, 14 graphs, 34 refs. Copenhagen, 1947. (With a Summary in English.)

In view of reports of mortality of honey bees following the use of insecticides in Denmark and demands by bee-keepers for legal protection, investigations on the cause of the losses and the toxicity to bees of various materials used in plant protection, including insecticides, fungicides, weed-killers and others, were begun in 1943 and are here described in detail. Recent literature on the subject is reviewed. A survey of cases showed that all were associated with treatment while the plants were in flower. Dusts appeared to be more injurious than sprays. There was little or no evidence that bees ingested spray droplets, but dust particles were collected with the pollen and taken to the hive, where the brood and nurse bees were affected. Most cases of poisoning were due to the use of arsenicals, but cryolite was also toxic. A spray preparation of dinitro-o-cresol was introduced in 1945 and caused much loss of bees. DDT proved less toxic than had been feared and appeared to be harmless in several instances even when flowering crops were dusted.

The toxicity tests were carried out by feeding 10 cu. mm. 50 per cent. sugar solution containing the material under test to individual bees by means of a micropipette, dusting bees for one minute in a bell-jar, dipping them for 15 seconds in solutions or suspensions, and spraying them. The arsenicals all proved highly toxic in the feeding tests, and the concentrations giving 50 per cent. mortality in two weeks were found to be 1–2 : 10,000, 1 : 10,000, and 1–2 : 10,000 for the arsenates of lead, calcium and zinc, 1 : 25,000 for paris green and 1–2 : 5,000 for a proprietary powder containing 30 per cent. calcium arsenate and 42 per cent. cryolite, the corresponding amounts of metallic

arsenic in mmg. per bee being 0·19–0·39, 0·25, 0·21–0·41, 0·15 and 0·15–0·29, which agreed very well with the results of Himmer [*R.A.E.*, A **23** 299]. Cryocide (80 per cent. cryolite) was much less toxic and appeared to involve no risk at concentrations below 1 : 500. As a dust, 20 mg. cryocide per 400 sq. cm. caused no more mortality than occurred in the control, but higher dosages were injurious. The dinitro-o-cresol preparation was toxic in feeding tests at concentrations greater than 1 : 10,000 but appeared to have no cumulative effect on repeated treatment.

Proprietary preparations containing about 5 per cent. DDT were not toxic when ingested at a dilution of 1 : 25, and a 5 per cent. DDT dust caused little mortality at 80 mg. per 400 sq. cm. As a dip, 5 per cent. DDT diluted 1 : 50 and 1 : 75 caused hardly any deaths, but the presence of alcohol in the dip increased toxicity. In feeding tests, undiluted DDT (85 per cent. pure) caused no mortality at 1 : 100, but 60 per cent. within a day at 1 : 50. When it was dissolved in a small amount of alcohol before being added to the sugar solution, the limit of safety lay between 1 : 250 and 1 : 400, according to the amount of alcohol used. Starvation before treatment increased mortality. As a spray, undiluted DDT dispersed in water by means of alcohol caused about 50 per cent. mortality when diluted 1 : 250 and applied at 6·5–9·3 gm. liquid per sq. m., but a concentration of 1 : 500 was much less harmful, even at higher rates of application. The hairs appeared to afford considerable protection. As a dip with alcohol, DDT caused little mortality at 1 : 2,500, which was close to the safety limit. Treatment with DDT led to abnormal activity before death, the symptoms of which are described. It is concluded that DDT at the rates used in the field presents no danger to bees.

BHC (benzene hexachloride) containing 10 per cent. γ isomer proved much more toxic, concentrations of 1 : 4,000 in alcohol and sugar solution giving complete mortality in a day, and only concentrations of 1 : 10,000 were non-toxic. Dipping at 1 : 5,000 and 1 : 10,000 also caused complete mortality in a day, and BHC further had a powerful fumigant effect. It is concluded that it should not be used on or near plants that are in flower.

Staniland (L. N.). **Hot-water Treatment of Plants.**—*Agriculture* **54** no. 6 pp. 278–282, 1 fig., 6 refs. London, 1947.

A cheap, easily-made bath for the hot-water treatment of small quantities of bulbs and plants against various pests is described, and instructions are given for its use. Treatment is carried out at 110°F., and the pests against which it is effective in Britain include larvae of narcissus flies [*Merodon equestris*, F., and *Eumerus* spp.] and several mites on *Narcissus* bulbs, which should be treated for one hour [*cf. R.A.E.*, A **21** 448 ; **22** 490 ; **30** 488], and the strawberry mite, *Tarsonemus* [*pallidus*, Banks], on strawberry runners [**22** 234, 581].

Blencowe (J. W.) & Caldwell (J.). **Aspermy—a new Virus Disease of the Tomato.**—*Ann. appl. Biol.* **36** no. 3 pp. 320–326, 1 fig., 6 refs. London, 1949.

A previously undescribed virus disease of tomato for which the name aspermy is here proposed was observed on out-door tomato plants in south-western England in 1944 and has since been reported from various areas, usually in market gardens with mixed crops. As a result of infection, the main growing point of the stem is inhibited, a proliferation of shoots is produced and the number of fruits set is reduced ; the fruits set after infection are usually small and often distorted and do not produce seed. The symptoms were much less conspicuous in warm weather and in greenhouses. In experiments, the virus

was transmitted by sap but not through the seed. It was transmitted by sap to tobacco (*Nicotiana tabacum*) in the young leaves of which it produced a yellow mosaic that later became dark green and approximated at times to a ring-spot pattern, and to *N. glutinosa*, on which it caused distortion of the leaves and flower buds, but not to five other solanaceous plants or to cucumber. *N. glutinosa* was infected by inoculation from chrysanthemums growing near the tomatos on which the disease was first observed. The symptoms on chrysanthemums comprised faint mottling, a general slight chlorosis, and some stunting.

Attempts to transmit the virus from tomato or tobacco to tomato by means of *Myzus persicae*, Sulz., *Aphis fabae*, Scop., *Macrosiphum* (*Macrosiphoniella*) *sanborni*, Gill., *M. solanifolii*, Ashm. (*euphorbiae*, auct.) and unidentified Aphids found on a diseased tomato plant in the field were unsuccessful, but *Myzus persicae* readily transmitted it from infected to healthy tobacco. A higher proportion of infections was obtained when the Aphids were starved overnight and then allowed to feed for three minutes on the infected plant than when they were fed overnight on the infected leaves. The systemic symptoms in *N. tabacum* and *N. glutinosa* are similar to those produced by the virus of cucumber mosaic, but no immunological relations could be found between the tomato virus and two strains of cucumber-mosiac virus, and it must therefore be distinct. Observations on the spread of the disease under field conditions indicated that this is sporadic, which suggests the existence of an insect vector. The virus is thought to overwinter in chrysanthemums.

DALE (W. T.). **Observations on a Virus Disease of Cowpea in Trinidad.**—*Ann. appl. Biol.* **36** no. 3 pp. 327–333, 1 pl., 13 refs. London, 1949.

The results are given of a detailed study of a mosaic disease of cowpea that has been known in Trinidad since 1928. It is widespread in varieties of cowpea and in asparagus bean (another variety of *Vigna unguiculata*) and occurs occasionally in sunn hemp (*Crotalaria juncea*), soy bean, *Phaseolus mungo* and *P. aureus*, when these are growing near infected cowpeas, and in *Cajanus cajan* (*indicus*). All can be infected by rubbing their leaves with sap from an infected plant, but *C. cajan* is slightly less susceptible than the others. In cowpea, chlorotic lesions and, in young leaves, vein-clearing or mottling are produced on the inoculated leaves and mottling and blistering on the leaves that develop subsequently; sometimes, especially under greenhouse conditions, reddish-brown vein necrosis also occurs. The growth of young seedlings is checked, but the symptoms become less apparent as the plants become older. On the other crop plants, various types of mottling, chlorosis and vein clearing are produced. In addition, soy-bean plants are stunted, the leaves become crinkled the axillary shoots proliferate, and seed production is inhibited or greatly reduced, and sunn hemp is stunted and its leaves distorted. In inoculation experiments, lima bean (*Phaseolus lunatus*) and its large-seeded variety (var. *macrocarpus*) developed symptoms resembling those on cowpea, but appeared to be less susceptible than the other crop plants. Several wild and introduced leguminous plants showed systemic symptoms on inoculation, and local lesions developed on inoculated leaves of *Dolichos lablab* and *Canavalia ensiformis*, but the virus could not be recovered from other parts of these plants. It could not be transmitted to runner bean (*P. vulgaris*), cucumber, tomato, tobacco, or *Nicotiana glutinosa*. Mosaic symptoms occur on wild species of *Crotalaria*, *Desmodium*, *Dioclea* and *Stizolobium* (*Mucuna*), but attempts to transmit virus from them to cowpea were unsuccessful.

The virus was transmitted through the seeds of asparagus bean, but not through those of any of the varieties of cowpea tested, and by adults of *Andrector* (*Cerotoma*) *ruficornis*, Ol., that were allowed to feed for three minutes

on infected plants and were then transferred direct to healthy ones for a similar period ; some that fed on the diseased plants for several hours were still infective six days later. This Galerucid attacks leguminous plants and is especially destructive to cowpea in Trinidad. It is undoubtedly of importance in spreading the virus in the field and its preference for *V. unguiculata* probably accounts for the high incidence of the disease on this plant. Successive crops of cowpea or asparagus bean should not be planted in close proximity, since the beetles migrate from the older plants to the young ones, and it is undesirable to plant other susceptible leguminous plants near to them. Attempts to transmit the virus by means of *Aphis medicaginis*, Koch, which has been found to be the vector of catjang mosaic in India and feeds on cowpea in Trinidad, where it sometimes becomes abundant in greenhouses, were unsuccessful.

The Trinidad virus is shown to differ in properties and host range from certain Aphid-borne viruses of *V. unguiculata*. In addition to the Indian catjang mosaic, there are mosaics of cowpea in China [*R.A.E.*, A **37** 52] and of cowpea [**29** 502] and asparagus bean [**30** 599] in the United States. It also does not appear to be related to the virus cucumber mosaic, strains of which produce mottling in cowpea, but may be identical with a virus causing mosaic of cowpea that is transmitted in the United States by *Cerotoma trifurcata*, Forst. [**12** 500].

BROADBENT (L.). **The Grouping and Overwintering of *Myzus persicae* Sulz. on *Prunus* Species.**—*Ann. appl. Biol.* **36** no. 3 pp. 334–340, 4 refs. London, 1949.

The oviparae of *Myzus persicae*, Sulz., deposit fertilised winter eggs on almost any species of *Prunus* in autumn, but it has hitherto been thought that the fundatrices that hatch from them in spring develop and produce colonies only on peach and nectarine [*R.A.E.*, A **34** 367] and, in Canada, on *P. nigra* [**31** 129]. During the autumns of 1945 and 1946, oviparae and eggs were observed in southern England on peach, nectarine, cherry and an ornamental almond-peach hybrid. In the following springs, no fundatrices were found on cherry, but those on peach and nectarine gave rise to very large colonies and those on the hybrid to small ones. In the spring of 1948, the colonies on the hybrid were as large as those on peach and nectarine, and many alatae were produced.

It has been observed in autumn that the gynoparae of *M. persicae* congregate in groups on the leaves of the winter food-plant, and this was found to be the case also on almond-peach, as many as 33 occurring on single leaves. The distribution followed no distinct pattern. In experiments on the means by which the winged Aphids find their winter food-plants, alates from which the antennae had or had not been removed were liberated under a glass containing uninfested peach leaves, and others were given access to leaves that were or had been infested and leaves from which the glands had been removed. The results did not support the theory that the food-plants are found by means of the olfactory sense, nor that flying Aphids are attracted to other Aphids or to honey-dew on the food-plant. It is concluded that the gynoparae find their food-plant by chance and tend to remain in groups when they meet one another while crawling on it. Some evidence of such a tendency was demonstrated in experiments in which the distribution of Aphids in glass containers kept in darkness was recorded at intervals.

TEN HOUTEN (J. G.) & KRAAK (M.). **A vertical Spraying Apparatus for the Laboratory Evaluation of all Types of liquid Pest Control Materials.**—*Ann. appl. Biol.* **36** no. 3 pp. 394–405, 1 pl., 5 figs., 5 refs. London, 1949.

Investigations in Holland during the war showed that the apparatus designed by Tattersfield [*R.A.E.*, A **23** 81] was unsatisfactory for the accurate

evaluation of liquid insecticides, since the area that could be covered evenly with the spray deposit was small and the nozzle was difficult to readjust after cleaning. A modification of it was therefore developed and is here described ; accounts are also given of the spraying techniques employed and of tests made to determine its accuracy. A feature of the apparatus is the atomising nozzle, which is made of stainless steel and can be quickly and accurately readjusted after removal for cleaning by means of a calibrated adjusting nut and a fixed vertical pointer. It is provided with three interchangeable metal tips with diameters of 0·45, 0·7 and 1 mm., enabling it to be used for homogeneous liquids of different viscosities as well as emulsions and suspensions. The tip is concentric with the outer air jacket and can be moved up or down. The nozzle is connected to the spray reservoir and to devices for ensuring an even flow of clean, compressed air and discharges the spray downwards into a plexiglass cylinder placed a little above a brass plate with a 12-cm. central hole covered by a masking disk. The disk is removed when the cylinder is full of a homogeneous spray cloud, and the spray then passes through the hole to a moveable object table fixed to one of the legs of the supporting stand. Three types of spray reservoirs are employed, according to whether the apparatus is to be used for emulsions and suspensions, straight oils, or solutions in kerosene. When the type of spray requires it, the dosage is controlled by means of two rotating superimposed disks, each with an open sector with an angle of 77°, placed below the spray opening in the brass plate. They can be moved on each other to diminish the total sector width, and are rotated simultaneously by means of a synchronous motor.

The apparatus gave very satisfactory results in experiments with solutions, emulsions and suspensions applied as contact sprays or ovicides or to leave toxic residues on different surfaces, and in phytocidal tests. Slight modifications were necessary to suit the type of experiment. The accuracy of the replication of the deposit is about the same as that given by the apparatus developed by Potter [**29** 591], the literature on which was not available at the time, and the nozzle designed by Hewlett [**36** 420].

Toledo (A. A.), Duval (G.) & Sauer (H.). **A broca do café.** [The Coffee Berry Borer.]—*Biológico* **13** no. 7 pp. 113–118. São Paulo, 1947.

Recommendations for the control of the coffee berry borer [*Stephanoderes hampei*, Ferr.] in São Paulo, Brazil, are based on two complementary measures, the collection of as many as possible of the fruits that remain in the coffee plantations after harvest and the release of its Bethylid parasite [*Prorops nasuta*, Wtstn.] in them [*cf. R.A.E.*, A **25** 787 ; **35** 105, etc.]. Both are normally essential, and in 1939, a year that was favourable to the Scolytid, they kept infestation at a low level. In the following years, growers relied on the parasite alone to effect control and were apparently justified, but the absence of severe infestation was largely due to the depressing effect on beetle increase of a series of dry years. Infestation reached its minimum in 1944, and though 1945 was a year of normal humidity, the Scolytid was unable to increase sufficiently to cause noticeable damage. It became more numerous in 1946, however, and there was a serious outbreak in 1947. This was not due to any loss of efficiency on the part of the parasite, as was popularly believed, but to the neglect into which the collection of fruits after harvest had fallen, which was accentuated in many cases by shortage of labour. The effect of the parasite could be increased by successive liberations during the year, particularly between crops, but this has so far not proved possible, the releases being made only at picking time, when the parasites are most numerous but immature hosts scarce. Drought reduces the efficiency of the parasite because the beetle is then not only less numerous but breeds between crops mainly in fallen fruits, in

which parasitism is never high [*cf.* **32** 110]. Both host and parasite are thus depressed by drought and favoured by humidity, and the necessity of the auxiliary measure of control in favourable years is apparent.

HEINRICH (W. O.). **Resinose do fruto do abacaxí.** [Resinosis of Pineapple Fruits.]—*Biológico* **13** no. 7 pp. 119–122, 1 pl., 3 figs. São Paulo, 1947.

Pineapples are being extensively grown in São Paulo, Brazil, but are severely attacked by pests, of which the most important is *Thecla basilides*, Geyer. All stages and the life-history of this Lycaenid are briefly described [*cf. R.A.E.*, A **16** 158]. It has numerous wild food-plants, the commonest being wild pineapple (*Ananas microstachys*), and the adults migrate from these to the pineapple fields. The egg and pupal stages last five and nine days, respectively. The tunnelling of one larva is sufficient to render a fruit worthless, but up to 18 eggs have been observed on individual fruits in September, when infestation is at its height. Up to 50 per cent. of the fruits of the second crop are sometimes infested. Recommendations for control include the destruction of abandoned infested pineapple fields during the winter, when few adults are present to fly to new plantations, or the turning of cattle into them to feed at a time when young fruits are present, and, if possible, keeping the fields free from fruits in June and July. In tests begun in 1945, a spray of 4 lb. lead arsenate, 5 lb. linseed oil, 2 gals. milk and 100 gals. water proved very effective against the larvae. It should be applied to the flowering heads and fruits, with special attention to their lower parts, but is best applied at the beginning of flowering.

CAMPACCI (C. A.). **DDT na conservação dos casulos do bicho da seda armazenados.** [DDT in the Preservation of stored Silkworm Cocoons.]—*Biológico* **13** no. 8 pp. 129–131, 1 fig. São Paulo, 1947.

Cocoons of the silkworm [*Bombyx mori*, L.] stored in a spinning factory at Piracicaba, Brazil, were found in 1945 to be damaged to the extent of 90 per cent. by larvae and adults of *Dermestes* sp. On receipt at the factory, the cocoons are placed in bags and heated, to kill the pupae in them, and are then stored in silos until required. The injury was found to occur during this period of storage, the Dermestids that developed from one lot of cocoons infesting the next and cutting the silk to arrive at the dead pupae within. Activity decreased in winter, but the population reached very high figures in the summer.

In experiments on the value of DDT for control, a 5 per cent. dust was applied at rates of 12·5 gm. or more to batches of 500 cocoons weighing about 220 gm. that were subsequently infested with adults and larvae of the Dermestid. All the latter were dead and the cocoons uninjured after six days, and a further test showed that the treatment had no deleterious effect on the silk after storage for one to three months. Tests were then made in silos at the factory. In the first, white and yellow cocoons were dusted with 5 per cent. DDT in talc, bagged and placed in the middle of a silo containing highly infested cocoons. A month later, only one or two of the treated cocoons near the outside of the bags had been injured, whereas untreated ones were almost all damaged. The silk was not affected by the treatment. In the second, the silo was first sprayed and brushed with an aqueous spray containing 0·01 per cent. DDT. The cocoons were dusted first on one side and then on the other with 5 per cent. DDT in talc, 75 gm. dust being used per 500 gm. cocoons, and the latter were then placed in baskets in the silo, by the side of heavily infested cocoons. After 20 days, numerous dead insects were seen on the walls and floor of the silo and the protection of the treated cocoons was almost complete, there being no breakages in the silk.

Chamberlin (W. J.). **Insects affecting Forest Products and other Materials.**—ix+159 pp., text ill., many refs., multigraph. Corvallis, Ore., Ore. St. Coll. coop. Ass., 1949. Price $2·75.

This book on the damage caused by invertebrate pests to timber has special reference to the United States and is intended primarily for foresters, engineers and others concerned with it from a practical standpoint. Emphasis is largely on the nature and identification of such damage and on its prevention and alleviation, but some information, varying in scope, is also given on the bionomics, appearance and habits of the pests responsible, which include some that injure living trees in such a manner as to cause defects in the products. The characters, structure and development of insects are briefly summarised in an introductory chapter, which also contains a synopsis of the types of damage found in wood products and the agents responsible for it. Of the subsequent chapters, nine are devoted to damage to wood by insects. Three deal with beetles of major and one with those of minor importance in unseasoned wood, and another with beetles that attack seasoned wood ; the remaining four are concerned with termites, moths, Hymenoptera and Diptera. Information on damage by wood-boring insects to metal, principally lead cables, is given in another chapter, and a concluding one is devoted to marine borers (Mollusca and Crustacea) that attack wooden structures in contact with salt water.

Young (E. G.). **Stability of Aerosol Formulations.**—*Soap & sanit. Chem.* **23** no. 11 pp. 116–117, 152A, 1 fig., 4 refs. New York, N.Y., 1947.

The author describes further investigations of substances thought likely to inhibit the corrosion that takes place in metal cylinders containing aerosol solutions and so increase the stability of the solutions [*cf. R.A.E.*, A **37** 185, etc.]. Sealed glass tubes of about 13 ml. capacity, each containing 5–6 ml. of a solution of DDT, pyrethrum concentrate (20 per cent. pyrethrins), APS–202 oil and Freon-12 [dichlordifluoromethane] (3 : 2 : 10 : 85), a strip cut from a commercially available one-pound aerosol container and the test compound dissolved in oil, were kept at 150°F. for six months, and periodical examinations were made of the condition and amount of corrosion of the strip, the character of the deposit on the glass and the condition of the liquid. The range of compounds tested covered most of the types recognised as corrosion inhibitors in a wide variety of systems. Salicylal amino guanidine, propylene oxide and dodecyl mercaptan proved to be excellent stabilisers of the aerosol formulation, and pinene thiophosphite, petroleum sodium sulphonate and 2-mercaptobenzothiazole had definite stabilising effects and may be considered satisfactory for use in aerosol formulations, but none of the amines, nitro compounds, quinone-type compounds or substituted 2-mercaptobenzothiazoles was sufficiently effective. It is not known what particular function the inhibitor performs in this aerosol formulation, and it is therefore difficult to predict the action of untested compounds.

It is concluded that the stability of solutions of DDT and pyrethrum in Freon-12 for insecticidal use can be improved by adding 0·001–0·1 per cent. by weight of any of the six substances found effective. The low concentrations at which they are used minimise any disadvantageous properties they may have.

Lidov (R. E.), Knous (H.) & Beckwith (C.). **Emulsifiable Concentrates of Chlordane.**—*Soap & sanit. Chem.* **24** no. 3 pp. 137–139. New York, N.Y., 1948.

Numerous formulae employing proprietary emulsifiers are given for the preparation of chlordan emulsion concentrates, and the physical properties of

the resulting emulsions are discussed. The concentrates, which are such as to require the minimum of agitation on dispersion in water, are prepared by stirring the components until a homogeneous blend is obtained; this can usually be facilitated by the application of mild heat, but in no case should they be heated to above 140°F.

Emulsions containing 2 per cent. chlordan prepared from concentrates consisting of equal weights of chlordan and emulsifying agent (Trex 60 or Trex 80) are highly stable for several weeks or months. They withstand low temperatures but not actual freezing. As these concentrates age, there is a change in their characteristics, as a result of which dispersion in water at concentrations giving 2 per cent. chlordan yields, in most cases, neither emulsions nor colloidal solutions but what appear to be true solutions. Tests indicate that the insecticidal potency of the chlordan thus bound is not adversely affected.

Emulsions containing 0·125–2 per cent. chlordan, prepared from concentrates consisting of 1 lb. chlordan, 0·25 lb. emulsifying agent (Atlox 1045A or Trex 40) and enough kerosene to make the specific gravity of the concentrate equal to that of the water with which it is used, are also very stable and are unaffected by changing temperature. It is essential in emulsions of this type that the specific gravity of the concentrate should be adjusted precisely to equal that of the water. Varying the amount of emulsifying agent alters the stability of the final emulsion, but it should remain within the range of 0·1–0·525 lb. per lb. chlordan.

The other concentrates, which contain chlordan, with or without kerosene, and various amounts of emulsifier, or in a few cases of two emulsifiers, produce emulsions of moderate or low stability. It is in emulsions of the latter type that changes in concentration of emulsifying agent have the most pronounced effects, and judicious selection and adjustment of the formulae given should make it possible to obtain a concentrate yielding an emulsion of almost any desired degree of stability.

Driggers (B. F.) & Darley (M. M.). **Experiments to control Curculio with Benzene Hexachloride.**—*Agric. Chem.* **3** no. 5 pp. 30–31, 33, 76–78. Baltimore, Md., 1948.

Experiments on the control of the plum curculio [*Conotrachelus nenuphar*, Hbst.] on peach by means of BHC (benzene hexachloride) were made in New Jersey by the senior author in 1946 and by both authors in 1947. All spray quantities are given per 100 U.S. gals. In 1946, sprays were applied at the shuck-split stage, ten days later and in some cases also ten days later still, and three commercial BHC powders were used at equal concentrations of γ isomer. Three sprays were more effective in reducing curculio injury than two, and two of the BHC powders were more effective than the standard lead-arsenate treatments in reducing the number of infested dropped fruits per tree. Lead arsenate caused varying amounts of foliage and twig injury, but BHC caused none. When adult weevils were caged with peach branches freshly sprayed with BHC or with lead arsenate and lime, they fed on and oviposited readily in the young peaches on branches treated with lead arsenate but refused to feed on those sprayed with BHC and kept as far as possible from them, indicating a repellent action.

In 1947, the basic schedule applied in a heavily infested orchard consisted of a shuck-split spray (13th May) and two cover sprays at intervals of ten days. Infested fruits began to fall at about the time of the second spray, and they were collected and examined at intervals from 23rd May to the middle of July. Four commercial BHC powders (referred to as A, B, C and D) were used, and analysis of these showed that they contained 7, 6·3, 5·6 and 6·2 per cent. γ isomer, respectively, and that 90·9, 76·3, 96 and 80·9 per cent. of the particles

passed a 325-mesh sieve. The total numbers of infested dropped fruits per tree by 24th June averaged 249 and 278 for 2 lb. lead arsenate with 12 lb. lime and 5½ lb. zinc sulphate or with 16 lb. lime, respectively, 8·2, 11·4, 17·1 and 25·5 for three applications of 2 lb. A, B, C and D, 9·5 when 12 lb. lime and 5½ lb. monohydrated zinc sulphate were added to 2 lb. A, 28·6 when the concentration of A was reduced to 1½ lb., 4·2 when it was increased to 3 lb., 17·1 when 2 lb. A was applied three times at weekly intervals from 13th May, and 2·8 when 2 lb. A was applied five times at five-day intervals from 13th May to 2nd June. At the time of the second application, it was found that none of the BHC sprays killed as many as 25 per cent. of the adults. In a further test, trees that had been sprayed with lead arsenate and lime at the shuck-split stage were sprayed with BHC on 23rd May and 2nd June, and the effect of two wetting and deposit-building products was tested. The numbers of infested drops per tree by 24th June averaged 24·4 and 33·1 for 2 lb. A and B, respectively, 11·9 and 18·6 when ¼ lb. Z–1 and 1 U.S. pint Orthex were added to these, respectively, and 18·3 for 5 lb. of a new formulation of 20 per cent. BHC.

Although BHC appeared to lose its effectiveness in preventing attack two to three days after application and killed few adults, it resulted in far lower infestations of dropped fruit than lead arsenate, and the evidence indicated that the eggs or larvae or both were being killed in the fruit. To investigate this, peach twigs bearing small peaches from an unsprayed orchard were caged for oviposition with adults for five days, after which they were placed in peach trees and sprayed with BHC or hexaethyl tetraphosphate or left unsprayed. Eight hours later they were returned to the outdoor insectary, and the peaches were dissected a week later to determine the percentages infested. These were 28·5, 17·6 and 0 for no treatment and treatment with the phosphate and BHC, respectively. When heavily infested dropped fruits under trees that had been sprayed with lead arsenate were sprayed with 2 lb. A, and these and similar fruits that had received no additional spray were caged until the larvae emerged, the numbers emerging from about 400 fruits of two varieties were 38 and 66 for BHC and 319 and 285 for no additional treatment. Dissection of peaches at various dates revealed many dead larvae in the fruits sprayed with BHC, but none in the unsprayed fruits.

In a further field test, two applications of 3 lb. A or 5 lb. 20 per cent. BHC, with wettable sulphur, were compared with lead arsenate, sulphur and lime and with no treatment but sulphur in a lightly infested orchard. The first was applied on 26th May, when the husks were three-fourths off the peaches, and the second a week later, and dropped fruits were collected for five weeks from 5th June. The numbers of infested dropped fruits per tree were 3·4 and 2·4 for the two BHC sprays and 181 and 65 for sulphur and lead arsenate, respectively.

HALL (S. A.) & JACOBSON (M.). **Chemical Assay of Tetraethyl Pyrophosphate.**—*Agric. Chem.* **3** no. 7 pp. 30–31, 3 refs. Baltimore, Md., 1948.

Tetraethyl pyrophosphate is the principal active ingredient in the mixture that has been called hexaethyl tetraphosphate [*cf. R.A.E.*, A **37** 214], though there is some evidence that pentaethyl triphosphate is another active constituent. Relatively inactive ingredients are ethyl metaphosphate and triethyl orthophosphate. Schrader's original method of preparing hexaethyl tetraphosphate from triethyl orthophosphate and phosphorous oxychloride has been modified to give a reaction product containing more tetraethyl pyrophosphate, and consequently of higher biological activity, by increasing the proportion of triethyl orthophosphate, and a new procedure utilising phosphoric anhydride in place of phosphorous oxychloride to react with triethyl orthophosphate has been developed. In all cases the reaction products are mixtures

that approximate to empirical formulae indicated. They contain different proportions of triethyl orthophosphate, ethyl metaphosphate and tetraethyl pyrophosphate, the last accounting for substantially all the biological activity when the product is applied in aqueous medium.

A method has been developed for the isolation of tetraethyl pyrophosphate from these reaction mixtures, based on the differential hydrolysis of a given mixture followed by solvent extraction of the largely unhydrolysed tetraethyl pyrophosphate and triethyl orthophosphate. The proportion of tetraethyl pyrophosphate to triethyl orthophosphate in the extractive can be determined by direct separation through vacuum distillation, refractive index determination (if all traces of solvent are removed) or titration with standard alkali of the diethyl orthophosphoric acid produced by hydrolysing the tetraethyl pyrophosphate without effecting hydrolysis of the triethyl orthophosphate. The third method has been shown by experiment to give the most conveniently reproducible results, and it was therefore selected as a basis for an analytical technique that is described and discussed in this paper.

GRAY (H. E.). **Protecting Canada's stored Grain by Chemical Controls.**—*Agric. Chem.* **3** no. 9 pp. 36–37, 39, 59, 3 figs. ; no. 10 pp. 37–39, 69. Baltimore, Md., 1948.

During the war, large quantities of wheat and other grain grown in Canada had to be stored for considerable periods before shipment abroad. It was stored on commercial premises, including elevators, on farms and also on boats on the Great Lakes, where it is customary for the boats to load with grain at Fort William in late November or early December, take it to elevators on the Great Lakes, and unload during the winter or early spring, before the opening of lake navigation. Both these boats and ships carrying the grain to other countries were carefully inspected and cleaned when necessary before loading. Contact spraying with pyrethrum extract or fumigation with hydrocyanic acid gas was sometimes carried out in the sea-going ships. Since the war, considerable attention has been devoted to the inspection of stowage sacks for infestation. These are usually carried in the ship from port to port and used as required to prevent the shifting of the cargo at sea, and appropriate treatments have been carried out when necessary, usually on board the ship.

Most cases of infestation by insects or mites occurred in grain in temporary storage. The advantage of low winter temperatures is largely lost in large storage units because of the insulation provided, and it is difficult to maintain the temporary structures in a weather-tight condition, so that moisture frequently reaches the grain and results in damaging infestations. Moisture tends to accumulate at the large grain surface in the temporary stores, and this greatly favours the development of grain mites.

The continuance of storage over long periods caused a sequence of infestation problems. During 1940 and 1941, grain mites were the principal pests. In 1941, *Laemophloeus ferrugineus*, Steph., occurred in a few places, and in 1942 it was the major pest encountered [*cf. R.A.E.*, A **34** 320]. *Calandra* (*Sitophilus*) *oryzae*, L., and *C.* (*S.*) *granaria*, L., were taken for the first time in commercially stored grain in central and southern Manitoba [*loc. cit.*], and Ptinids, which are normally pests of flour [*cf.* **35** 99 ; **38** 55], were frequently found infesting the surface of stored wheat. The Psocid, *Liposcelis divinatorius*, Müll., which was formerly regarded as harmless in stored grain, was found to cause heating of grain in the annexes of large terminal elevators. The direct damage to stored grain in Canada was relatively small, the most abundant pests confining their attack to the germ end of the kernel or feeding in the débris with the grain, but indirect damage, due to the increase of temperature and moisture

content of the infested grain, was considerable. In some cases, large quantities of grain had to be turned and moved because of infestation.

Preventive measures were extensively used and involved regular inspection of the grain to detect incipient infestations. Localised infestations were detected by the use of multiple sample probes ; the fact that they were known to occur most often in the central part of the grain mass greatly reduced the area in which intensive probing was necessary and permitted their detection before they became serious. The annexes of many country and terminal elevators were emptied each year, and before refilling, any cracks in the floor were sealed with asphalt and the floors were dusted with slaked lime ; insecticidal sprays were used in some cases. All railway waggons that had carried infested grain were thoroughly cleaned, and the infested grain was cleaned and put in elevator bins in which it could readily be turned or fumigated. Where infestations of *C. oryzae* and *C. granaria* were encountered, the grain was fumigated and put under quarantine and then used in such a way that the contamination of public premises or carriers was avoided.

Of the grain mites found, *Tyroglyphus farinae*, Deg., was the most important, and *Glycyphagus cadaverum*, Schr., *G. domesticus*, Deg., and *Caloglyphus* sp. were also injurious. Several predacious mites, including *Cheyletus eruditus*, Schr., and Gamasids, were associated with *T. farinae*. Mite infestations occurred chiefly in the annexes associated with country elevators and in farm granaries, and were heavy only in grain with a moisture content of 14 per cent. or more ; temperature was of less importance, as mites breed at temperatures as low as 40°F., though the optimum is about 65°F. Mite infestations were most common in 1940–41, when the grain stores were filled to the roof with little provision for ventilation, and condensation occurred on the grain surface. In 1941–42, when the grain level was kept low and ventilators were installed to produce a good flow of air over the surface of the grain, they were of much less importance. In terminal elevators, where cleaning equipment was available, the grain was cleaned, most of the mites were removed, and the moisture content was reduced ; merely turning the grain often prevented further trouble. In the annexes, the best control was given by fumigation with chlorpicrin or carbon tetrachloride or a mixture of the two, applied just below the surface by means of short probes. In farm granaries, shovelling the surface grain, putting the grain through a fanning mill, threshing machine or combine, or transferring it from one bin to another all helped to control mites.

Laemophloeus was a serious pest in both country and terminal elevators, and infestations developed very rapidly. Heavily infested grain heated seriously, sometimes reaching a temperature of 107°F. Fumigation of localised infestations with chlorpicrin or carbon tetrachloride usually gave only partial control, and it was necessary to remove the grain from storage, clean it and use it as soon as possible ; large quantities of grain had sometimes to be moved to control localised infestations. *Liposcelis* was frequently found with *Laemophloeus* in heating grain and was apparently able to cause dry grain to heat in the same manner. The feeding of Ptinid larvae was restricted to the surface layers of kernels, and the damage to the grain was of minor importance.

Surveys of the farms furnishing grain found to be infested by *Calandra oryzae* failed to reveal its presence in farm granaries. A single infestation of *C. granaria* in a large annex near Winnipeg was completely controlled by fumigation with chlorpicrin. Heavy infestations of the Indian meal moth [*Plodia interpunctella*, Hb.] were found in elevators at the Bay Ports and on the Pacific Coast and light ones in a few country annexes. Fumigation with hydrocyanic acid gas from discoids yielded good control of the adults and larvae on the surface, but penetration into the grain was not great. The method of application greatly affected the results secured with fumigants heavier than air ; when they were sprinkled on the surface grain, the fumigant sank rapidly

below the site of infestation and yielded only partial kill, but very satisfactory results were obtained against larvae and adults with chlorpicrin sprayed into the space above the grain. The most widely used method of control was to spray with 10 per cent. pyrethrum extract (0·48–0·72 per cent. total pyrethrins) in oil. This was applied to the space above the grain in the bins at the rate of 5–6 oz. per 1,000 cu. ft. space shortly after the moths appeared in early summer and at least once a week as long as living insects could be found. Persistent treatment completely freed several elevators from infestation.

RILETT (R. O.). **The Biology of** *Cephalonomia waterstoni* **Gahan.**—*Canad. J. Res.* (D) **27** no. 3 pp. 93–111, 1 pl., 21 figs., 5 refs. Ottawa, 1949.

Cephalonomia waterstoni, Gah., a Bethylid parasite of *Laemophloeus ferrugineus*, Steph. [*cf. R.A.E.*, A **25** 117, etc.], was taken in considerable numbers in grain from a flour mill in Ontario and from feed storage buildings in Wisconsin. It appeared in Wisconsin in 1944 in laboratory stocks of the beetle derived from a culture from Canada, and a study was made of its bionomics at 90°F. and 65–75 per cent. relative humidity to discover its value as a control agent for *Laemophloeus*. The results of the investigation are given, together with descriptions of all stages of *C. waterstoni*, including the hitherto unknown male. Eggs are laid on fourth-instar larvae and sometimes pupae of the host, one or two, or rarely three, being deposited on each. The larvae are paralysed and carried off to a secluded spot before oviposition. The larvae of the parasite hatch after 30 hours, and feed on the haemocoelic fluid of the host, but are unable to complete development if the host dies too soon. One host can support two larvae, but where three eggs were laid on one host, usually only one parasite completed its development. The larvae became full-fed in about 23 hours and then left the host and constructed silken cocoons in which they entered a prepupal stage, after two days. They pupated after a further two days, and the adults emerged five days later. Mating took place shortly after emergence, if males were present, and oviposition could begin one day after emergence. The adult females survived for about three weeks and the males for a much shorter period. Unfertilised eggs give rise to males only, but unpaired females sometimes mate with their progeny. Females were observed chewing the larvae of *Laemophloeus*, and probably imbibe fluid from holes pierced in them. The ratio of males to females among the progeny of 22 mated females was about 1 : 2. The females deposited an average of 1–3 eggs a day, but sometimes laid as many as eight.

In experiments on the effect of the parasite on populations of *L. ferrugineus*, in which ten parasite females were introduced into U.S. pint jars containing wheat that had been infested one month earlier with 25 adults of *Laemophloeus*, the numbers of beetles 40 days later were only one-third as great as those in the control jars. A very marked but rather smaller reduction took place in 35 days when 25 parasites were introduced into cultures established 13 days earlier.

RILETT (R. O.). **The Biology of** *Laemophloeus ferrugineus* **(Steph.).**—*Canad. J. Res.* (D) **27** no. 3 pp. 112–148, 1 pl., 36 figs., 13 refs. Ottawa, 1949.

Wheat is not normally stored for long in Canada, and for this reason and because of the low winter temperatures, expecially in the west, insect infestation is practically negligible. During the war, however, it became necessary to keep wheat in stores of various kinds, and *Laemophloeus ferrugineus*, Steph., which in California is regarded as a secondary pest of stored grain [*R.A.E.*, A **32** 267], became a major pest and, in western Canada, the most important one [*cf.* **38** 156]. A study of its bionomics [*cf.* **20** 618; **25** 117] was begun

in Ontario and completed in Wisconsin, and an account of the work is given, together with descriptions of all stages.

Eggs were laid through cracks in the wheat grains in the germ region below the outer layers of the seed coat, between the grains, and among the detritus. The larva fed on the germ and the endosperm and at temperatures or humidities below 90°F. and 75 per cent., respectively, attacked more than one grain. Pupation normally occurred in the shell left after the consumption of the wheat germ, but sometimes between the grains and in holes in the grain detritus. The adults fed in damaged grains, often within empty larval burrows, and on wheat dust. At 90°F. and relative humidities of 65–75 per cent., they survived for an average of 6–9 months when provided with cracked wheat as food and for little more than eight days without food. They flew fairly well at high temperatures. The percentage of males among beetles taken from a normal population was 38·4. Mating took place a day or two after emergence, and oviposition began shortly afterwards ; the females laid at least 2–3 eggs daily in whole grain.

The following is based on the author's summary. Temperature greatly affected the rate of development. At a relative humidity of 75 per cent., eggs hatched in 4–5, 3–4 and 2–3 days at 80, 90 and 100°F. and the periods from hatching to adult emergence were 69–103, 26–38, 19–33 and 17–26 days at 70, 80, 90 and 100°F. First-instar larvae did not survive at 110°F. An increase in relative humidity between 50 and 75 per cent. accelerated development during the larval feeding period. Above 75 per cent., there was no significant acceleration. Mortality was very high at relative humidities below 50 per cent., and no larvae developed at 25 per cent. At 90°F., the periods from hatching to adult emergence were 28–42, 23–33, 19–25, 18–25 and 18–27 days at 50, 65, 75, 90 and 100 per cent. relative humidity. The optimum environmental condition for development was 90–100°F. at a relative humidity of 75 per cent. or higher.

Populations increased more rapidly in whole rye and wheat grain than in the same materials coarsely ground. The opposite was true in the case of oats, barley, maize, soy beans and seeds of sunflower and flax. Whole grains of rye, wheat, maize and rice were decreasingly susceptible to injury in the order named, while whole grains of oats and barley, the seeds of sunflower and flax and soy beans were practically free from injury at humidity levels normally occurring in stored grains and seeds. Although first-instar larvae gained access to the wheat germ of grain described commercially as being " whole, sound and undamaged ", they were unable to enter whole wheat grains that had no breaks in the bran layers. The breaks need be only microscopic in size to allow penetration by the larvae. Survival among larvae fed on wheat grains from which the germ had been removed was very low, but was greatly increased when the wheat was covered with a growth of mould or had been treated with diastase.

Morrison (F. O.) & Oliver (W. F.). **The Distribution of radioactive Arsenic in the Organs of poisoned Insect Larvae.**—*Canad. J. Res.* (D) **27** no. 5 pp. 265–269, 6 refs. Ottawa, 1949.

The following is virtually the authors' summary. Radioactive arsenic trioxide containing As^{76} injected in solution into the haemolymph of last-instar larvae of *Tenebrio molitor*, L., distributed itself throughout the haemolymph, body wall, fore-, mid-, and hindgut, and Malpighian tubules within an hour and showed little change in distribution after as much as 20 hours, even though most of the larvae remained alive. When injected into the gut it showed little signs of escaping. Fifth-instar larvae of *Protoparce* (*Phlegethontius*) *quinquemaculata*, Haw., absorbed only very small amounts of the dry active arsenic

trioxide when fed on leaves treated with it. The largest portion remained in the gut if the larvae died or was eliminated within 20 hours if it lived. As little as 10^{-11} gm. arsenic was detectable in the digested insect organs. The use of a dipping counter on aliquots of the acid tissue digest provides a simple and accurate means of counting samples and is to be recommended in studies of this nature.

ULLYETT (G. C.). **Distribution of Progeny by** *Chelonus texanus* **Cress. (Hymenoptera : Braconidae).**—*Canad. Ent.* **81** no. 2 pp. 25–44, 14 figs., 7 refs. Guelph, Ont., 1949.

Chelonus texanus, Cress., which parasitises various Lepidoptera [*R.A.E.*, A **34** 3, etc.], has been reared in large numbers on *Ephestia kuehniella*, Zell., and introduced into South Africa [**33** 74–75] for liberation against *Loxostege frustralis*, Zell., on *Pentzia* sp. [*cf.* **31** 148]. Its eggs are laid in those of its host, within the body of the embryo, but do not hatch until after hatching of the host larva. The way in which females find suitable hosts and distribute their eggs among them was studied by exposing eggs of *Ephestia* arranged on squared paper in batches of 20–200 to single females or to groups of 1–6 in watch glasses for 24 hours. The results are given in detail and discussed with reference to those obtained with *Bracon* (*Microbracon*) *hebetor*, Say [*cf.* **37** 56]. It was found that as host density increased, the total number of hosts attacked by single females increased rapidly whereas the proportion decreased gradually. The failure to parasitise all or almost all the hosts when they were few suggests that the females do not search systematically for hosts, but it is possible that the search at higher host densities was not entirely random. The females laid relatively few eggs when few hosts were present, presumably because more time was needed to find unparasitised eggs, but as the hosts became more numerous, the number of eggs deposited increased, though the rate of increase gradually diminished as the number of eggs laid within 24 hours approached the possible maximum. The females showed a strong tendency to lay only one egg in each host, and as only one parasite can develop in each, there cannot be more than one " effective " egg per host. The proportion of hosts with only one egg also increased with the number present, at first fairly rapidly, and later more gradually as the optimum host density was reached. The optimum density was approximately 150 host eggs per unit area (just over 21·7 sq. cm.), and the average number of eggs deposited at this density was 74. When the number of parasites to which the optimum number of hosts was exposed was varied, the number of hosts attacked and the total number of eggs deposited in 24 hours both increased with the number of parasites until this was three or four, after which it declined. The number of eggs and effective eggs per female, however, and the proportion of hosts in which only one egg was laid all steadily declined with increasing parasite density. Beyond a certain point, an increase in the total number of eggs laid was not accompanied by a corresponding increase in the number of effective eggs. The ability of the females to discriminate between parasitised and unparasitised host eggs was demonstrated by presenting individuals with equal numbers of both for an hour, when they laid almost twice as many eggs in the latter as in the former. Varying the total area of the environment, by using petri dishes instead of watch glasses, while keeping the host and parasite populations per unit area constant, had no significant effect on parasitism.

The efficiency of the parasite in controlling the host population and maintaining its own within a given area depends very largely upon the ratio between the hosts and parasites. An analysis of the data from the tests in which the parasite density was varied showed that the resulting effect on the efficiency of the parasites was due mainly to the deterioration in this ratio, and that, except

where parasite numbers are low, the effect that can be ascribed to parasite density as such is comparatively small. The nature of the data obtained affords evidence of non-random activity in the search of the environment by the parasite.

JUDD (W. W.). **The Red-legged Ham Beetle on imported Copra.**—*Canad. Ent.* **81** no. 2 p. 52, 3 refs. Guelph, Ont., 1949.

Large numbers of *Necrobia rufipes*, Deg., were found in copra, received from the Philippine Islands, in the warehouse of a vegetable-oil factory in Hamilton, Ontario, in July 1947. The larvae fed on the copra, but were not considered of importance as it was being used for the manufacture of oils and the residue for feed for livestock. The adults entered houses near by, where they constituted a nuisance, and some were found in a railway yard about three miles away. No control measures were employed, and the infestation died out as the copra was used.

MILLIRON (H. E.). **A new Aphelinid Egg Parasite of the Saratoga Spittlebug, *Aphrophora saratogensis* (Fitch) (Hymenoptera, Aphelinidae).**—*Proc. ent. Soc. Wash.* **49** no. 7 pp. 193–197, 1 fig., 2 refs. Washington, D.C., 1947.

Parasites reared from the eggs of *Aphrophora saratogensis*, Fitch, in Wisconsin in 1946 [*cf. R.A.E.*, A **37** 458] included an Aphelinid here described from adults of both sexes as *Tumidiscapus cercopiphagus*, sp. n. Limited observations showed that one or two adults emerge from a single host egg; they are active and pair soon after emergence. A key to both sexes of the four North American species of *Tumidiscapus* is included.

MINER (F. D.). **Injury to Raspberry by a Meadow Grasshopper.**—*J. Kans. ent. Soc.* **20** no. 3 pp. 86–87, 5 refs. Manhattan, Kans., 1947.

Damage to raspberry canes as a result of oviposition by *Orchelimum vulgare*, Harr. [*cf. R.A.E.*, A **18** 390] occurred in Arkansas for the first time in the autumn of 1945, when canes in a small planting were affected. It was produced over a period of several weeks from early October until the onset of cold weather. Similar injury was observed on several wild plants and on maize, Johnson grass (*Sorghum halepense*), rose and chrysanthemum, but in no case was it of economic importance, though damage to sorghum heads was recorded in the same State in 1893. Before depositing an egg in the pith of the cane, the female splinters the bark over an area about $\frac{1}{4}$ in. in diameter, and injury by this Tettigoniid can be distinguished from that due to Cicadids [**27** 165] by the arrangement of the splinters, which are broken in the middle and in consequence tend to point in two general directions instead of only one. Eggs in the stems of maize tassels kept in an outdoor cage during the winter and spring of 1945–46 began to hatch on 6th May. Adults were first observed in the field in the middle of August, but they caused little damage in 1946.

HILL (R. E.). **An unusual Weather Sequence accompanying the severe Potato Psyllid Outbreak of 1938 in Nebraska.**—*J. Kans. ent. Soc.* **20** no. 3 pp. 88–92, 8 refs. Manhattan, Kans., 1947.

The following is virtually the author's summary. A study of the weather data for Scottsbluff, Nebraska, during the 26-year period, 1921–1946, shows that the summer of 1938 was peculiar, in that an extraordinarily wet July with very few hot days was followed by two months of exceptionally warm weather. It was in 1938 that Psyllid yellows was unusually severe and was responsible for an estimated loss of 25 per cent. of the commercial potato crop. From

what is known of the seasonal life-history of the potato Psyllid (*Paratrioza cockerelli*, Sulč), such a weather sequence provides conditions approaching the optimum for the development of a heavy population of this insect [*cf. R.A.E.*, A **36** 144]. The absence or infrequent occurrence of hot July days permits it to migrate to the late crop and there become established on the small plants at a time when the foliage offers little protection from the heat. Later, however, when the leaves are dense enough to shade the lower portions of the plants and the soil surface, relatively high temperatures become essential for the maintenance of optimum developmental conditions. In order for serious Psyllid injury to occur in late potato fields of western Nebraska, there appears to be needed a source of early infestation, cool, moist weather in late June and July and an unusually warm August and September. Sources of initial infestations are not fully understood, but the increasingly popular local practice of removing potential spring and early summer breeding places through the elimination of early potato plantings and volunteer growth on cull dumps should serve to curtail Psyllid populations considerably. Such practices greatly lessen chances of another serious Psyllid outbreak in this area.

Suranyi (P.). **Ein neuer Schädling in Europa** (*Hyphantria cunea* (**Drury**)). [A new Pest in Europe, *H. cunea*.]—*Pflanzenschutzberichte* **2** pt. 3–4 pp. 33–42, 7 figs. Vienna, 1948.

Some of the information in this paper on the bionomics and spread of *Hyphantria cunea*, Dru., in Hungary has already been noticed [*R.A.E.*, A **36** 254]. All stages are briefly described. There is considerable variation in the coloration of the adults, and though males of the typical form with spotted wings were observed in the spring of 1947, adults of the summer generation were all white. Both white and spotted forms are produced from the eggs of a single female, and the white form, which is predominant, is considered to be a variety ; the author uses the name *textor* for it, as he adopts the view that *H. textor*, Harr., is conspecific with *H. cunea* [*cf. loc. cit.*]. The females lay several hundred eggs in a single batch, chiefly on the leaves of mulberry and *Acer negundo*, but also on those of fruit trees and many other deciduous trees and shrubs. The larvae have been observed on plants of 59 species in 44 genera, now including poplars and willows [*cf. loc. cit.*], a list of which is given. They are voracious, and those from a single egg-batch can completely defoliate a fruit tree 10–15 years old in a short time. The pupal stage is passed in crevices or other shelter on or off the trees. It lasts 8–10 days in summer, and the adults survive for 10–14 days. There are two generations a year [*loc. cit.*], the adults appearing in numbers in the first half of May and the second half of July, and winter is passed in the pupal stage. Some of the pupae that would normally overwinter gave rise to adults in September in 1947, when the autumn was warm, but their progeny did not develop.

The moth spread still further in 1947, reaching the frontiers of Czechoslovakia and Jugoslavia and to within a few miles of the Austrian border. Spread was slow to the north, and this is attributed to the prevailing north winds. It is favoured by the polyphagous habits and resistance to unfavourable climatic conditions of the larvae and the absence of natural enemies, though a very few parasitised larvae have been observed. The possibilities of control are considered doubtful. The measures in use comprise the destruction of the larval nests, spraying with DDT and calcium arsenate, which do not always give complete mortality even at high concentrations, deep cultivation of the soil in late autumn or early spring to kill any pupae present between clods of soil, etc., and burning fallen leaves and scraping the trunks in autumn, with special attention to cracks.

Beran (F.). **Auftreten und Bekämpfung des Kartoffelkäfers in Österreich.** [The Occurrence and Control of the Potato Beetle in Austria.]—*Pflanzenschutzberichte* **2** pt. 3–4 pp. 48–52. Vienna, 1948.

Leptinotarsa decemlineata, Say, was first observed on potato in Austria in 1940, when a few foci of infestation were found in the Vorarlberg, in the extreme west, but it did not spread to the east of that province until 1945 [*cf. R.A.E.*, A **35** 380]. It spread still further in 1946 and 1947, and its distribution in 1947 was that given in a paper already noticed [**37** 117], except that there were a few more infested districts in each of the affected provinces than previously mentioned. Infestation occurred throughout the Vorarlberg in 1946 and 1947 and was augmented by beetles flying in from Switzerland, Liechtenstein and Würtemberg, but neither that province nor the Tyrol is an important potato-growing area. Spread to other parts occurred mainly along the river valleys. The presence of the beetle in Upper Austria is more serious and there is constant immigration from Bavaria. The main potato-growing districts of the country, in Lower Austria, have so far remained free. The organisation of control measures to check the spread of the beetle to the east is outlined. Surveys are carried out, and foci of infestation are sprayed with 0·5–1 per cent. calcium arsenate and the soil treated with carbon bisulphide.

Karpiński (J. J.) & Strawiński (K.). **Korniki ziem Polski.** [The Bark-beetles of Poland.]—*Ann. Univ. M. Curie-Skłodowska* (C) Suppl. **4** 239 pp., 28 pls., 100 figs., 95 refs. Lublin, 1948. (With a Summary in French.)

This monograph on the Scolytids and Platypodids of Poland opens with a general account of their morphology, anatomy, physiology, bionomics and classification, followed by keys to subfamilies, tribes and genera, and descriptions of the species arranged according to their food-plants, notes being given on their external appearance, synonymy, distribution in Poland, food-plants, bionomics, mode of feeding, natural enemies and control. All are Scolytids except *Platypus cylindrus*, F. Descriptions are also given of 17 Scolytids that might occur in Poland, but have not yet been found there, and a further section contains a systematic list of the species observed in Poland, with references to their original descriptions. The geographical distribution of the Polish species is then discussed, and lists are given showing the trees or other plants attacked by each, the species that attack particular plants and the Hymenopterous parasites that have been recorded from Scolytids in Poland, showing the hosts. The book concludes with discussions on the rôle played by bark-beetles in the biocenosis of a forest, their economic importance and control, and the arrangement of collections. A list of the Polish names of the beetles referred to is appended.

Franz (J.). **Neues zur Bekämpfung des Buchdruckers, *Ips typographus* L.** [New Measures for the Control of *I. typographus*.]—*Anz. Schädlingsk.* **21** pt. 1 pp. 2–8, 4 figs., 10 refs. Berlin, 1948.

Investigations on improved methods of controlling *Ips typographus*, L., in spruce forests were begun near Munich in 1945–46. They showed that large numbers of the beetles may overwinter in the soil. They emerge from hibernation in April, when the temperature of the surface soil exceeds 9°C. [48·2°F.], at about the same time as beetles that have overwintered elsewhere, and their existence in unknown numbers renders any attempt to calculate the number of trap logs required nugatory [*cf. R.A.E.*, A **38** 88, etc.]. Before entering

the trees to oviposit, the beetles feed for a time (regeneration or maturation feeding) on the cambium layer in places where bark is loose on stumps of trees felled in the previous year and on trunks of standing trees, and are then concentrated in large numbers in comparatively small areas.

Experiments were made on the value of contact insecticides in killing the beetles at various stages of their spring activity. Soil treatment with proprietary dusts containing dinitro-o-cresol or DDT (Gesarol) and dusts and sprays of E605 [parathion] gave fair to high mortality of beetles emerging from hibernation, but only at impracticably high rates of application. In experiments with treated trap logs [*cf.* **37** 66; **38** 144], sections about 3 ft. long were placed on sheets in different situations in the forest and dusted or sprayed, the entrance holes of the beetles attracted to them were daily marked with pins, dead beetles on the sheets were collected, and about a week after the last entrance hole had been observed the logs were barked and living and dead beetles counted. The materials tested were E605f and Gesapon [emulsion concentrates of parathion and DDT, respectively], E605a [a parathion dust] and a DDT dust (Gesarol). The treatments killed higher percentages of the beetles and remained effective for 8–12 days longer in closed stands than in clearings, evidently as a result of greater exposure in the latter to sun and rain and quicker drying of the logs, but the absolute numbers of beetles killed were greater in the clearings. E605f at 0·5 per cent. was the most effective, giving 94·6 and 89·9 per cent. mortality and remaining effective for 37 and 24 days in the two situations, respectively, while at 0·1 per cent. it was about as effective in closed stands but much less so in clearings. The two dusts gave averages of about 70 per cent. mortality, and the DDT spray 22·7. Since more beetles were attracted to the logs in clearings, it is important to place about two-thirds of the trap logs in open sites at the beginning of the flight period. They should be treated with E605f or one of the dusts and exposed from the time of the appearance of the first beetles or entrance holes in the warmest sites till about the middle of May, when the flight period is drawing to a close, and a succession of logs in an attractive state can be used.

The number of trap logs can be reduced by destroying the beetles during their regeneration or maturation feeding period in spring. The beetles feeding beneath the bark of stumps or tree trunks were very effectively controlled by spraying with 0·1–1 per cent. E605f, a single application at the end of March or the beginning of April remaining effective for weeks. The best method against beetles feeding in numbers below the bark of trees 40–60 years old was to fell the trees and cut them into sections 6–7 ft. long, pile them into heaps with the loppings packed between, and set fire to the loppings, whereby the beetles are killed without damage to the wood.

FLACHS (K.). **Das Vordringen der San José-Schildlaus in Europa und Massnahmen zu ihrer Bekämpfung.** [The Penetration of the San José Scale in Europe and Measures for its Control.]—*Anz. Schädlingsk.* **21** pt. 1 pp. 9–11, 6 figs. Berlin, 1948.

The spread of *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., throughout the world is briefly reviewed, with special reference to Europe, and a list is given of various plants other than fruit trees infested by it. In Germany, it now occurs in the north of Baden and the Palatinate and in Hesse [*cf. R.A.E.*, A **37** 118, 404] and since observations in Russia have shown that it is very resistant to cold [**27** 315], there is a danger that it may spread throughout Germany. To prevent this, nurseries should be regularly inspected, all infested material destroyed and nursery stock fumigated before it leaves the nursery.

Holdaway (F. G.) & Gay (F. J.). **Temperature Studies of the Habitat of *Eutermes exitiosus* with special Reference to the Temperatures within the Mound.**—*Aust. J. sci. Res.* (B) **1** no. 4 pp. 464–493, 1 pl., 12 figs., 20 refs. Melbourne, 1948.

The following is the authors' summary of investigations in 1933–36 near Canberra. A study was made to determine whether or not *Eutermes exitiosus*, Hill, maintains within its mound a constant temperature at which it would be desirable to maintain artificial laboratory colonies of this termite. It was found that the temperature of the mound is not constant. The temperature of a given portion of the mound varies with the time of day, and varies from day to day with changes in environmental temperature. The temperature of the nursery exhibits less variation than other portions of the mound, but it is continuously higher than the temperature of the air or the soil, or of that portion of the mound which receives the greatest amount of heat from the sun. The temperature of the nursery follows a seasonal trend which roughly parallels the seasonal change in air temperature. Although the temperature of a mound is not constant, and although it is related to the surrounding air temperature, it is affected by the presence of living termites in the mound, the temperature of an occupied mound averaging from 14·5 to 18·6°F. higher than it would if it were unoccupied. The temperature of an occupied mound is apparently maintained above that of an unoccupied mound by the metabolism of the termites. The number of individuals present in the mound in the summer is less than the number present in the winter. By virtue of the higher temperature of the mound in the summer, and the resultant higher metabolism of the termites, the smaller number of individuals present in the mound is capable of maintaining the mound temperature as much above that of an unoccupied mound as is the larger number present in the winter. The presence of alates in the mound results in the temperature being from 10 to 13°F. higher than that in mounds of comparable shape and size in which there are no alates. Termites, probably as a result of movement into the mound from galleries away from the mound, are capable of buffering the effect of sudden falls in air temperature.

The practical applications of the observations on mound temperature are as follows: (*a*) By recording mound temperature, it is possible to distinguish populous from non-populous mounds. This ensures that when a mound is selected to provide termites for laboratory colonies, the maximum number of termites procurable from a mound at that particular time of the year will be secured. (*b*) By recording the temperatures of mounds chosen for field studies on the resistance of timbers and timber treatments, one can be sure of using only vital colonies, and can also keep a check on the vitality of the respective colonies throughout the period of the test. (*c*) By recording the temperature of mounds used for insecticidal studies, it is possible to compare the effects of various toxic materials on termite colonies which are known to be normally healthy at the time of treatment.

Day (M. F.) & Powning (R. F.). **A Study of the Processes of Digestion in certain Insects.**—*Aust. J. sci. Res.* (B) **2** no. 2 pp. 175–215, 5 pls., 5 figs., 52 refs. Melbourne, 1949.

The following is virtually the authors' summary. Several aspects of the processes of digestion in *Blattella germanica*, L., *Periplaneta americana*, L., and *Tenebrio molitor*, L., are reported. In *Blattella* starved for two days, a meal of coloured starch reaches the midgut within ten minutes and the rectum within five hours. The pH of the gut contents on a starch diet is approximately

4·5 in the crop, 6 in the midgut, and 8 in the hindgut. A protein diet raises the pH of the crop to about 6, but does not change that of the other regions. There is a gradient of decreasing oxidation-reduction potential from the crop to the hindgut where the *Eh* approximates −0·1 V. at pH 8.

Concurrent quantitative enzyme estimations and cytological investigations on *Blattella* have proved that the presence of cytoplasmic globules, hitherto generally referred to as cytological evidence of secretory activity, is not associated with an increase in enzyme concentration in the gut contents. The greatest enzyme concentrations are found when the cytoplasm is cytologically uniform. The secretory globules are more probably signs of cell breakdown than an indication of secretory activity.

Digestive enzymes are still present in *Blattella* midgut contents after three days' starvation, but the enzymes studied increase in concentration when the insect is fed, irrespective of the diet. A digestive enzyme of *Blattella* decreases in amount when the insect is fed a diet of that particular enzyme substrate for some time. The enzyme concentration is fairly slow to regain its former level.

Evidence is presented that stimulation of epithelial regeneration of the midgut of *Tenebrio* is effected by a factor carried in the blood. There is some evidence, mainly morphological, against the nervous control of midgut secretion.

A study of the localisation of various substances shows that different materials may be absorbed in different regions of the gut. Fore-, mid-, and hindguts, and the midgut caeca may all be involved in absorption. Observations on the histopathology of a number of insecticides in the cockroaches suggest that, except for arsenic compounds, changes produced in the midgut are not sufficient to account for death of the insect.

CANNON (R. C.). **Investigations in the Control of the Potato Tuber Moth, *Gnorimoschema operculella* Zell. (Lepidoptera : Gelechiidae), in North Queensland.**—*Qd J. agric. Sci.* **5** no. 3 pp. 107–124, 6 refs. Brisbane, 1948.

The following is almost entirely the author's summary. Studies of the food-plant relationships, seasonal history and egg-laying habits of *Gnorimoschema operculella*, Zell., experiments on its control on potatoes with DDT and BHC (benzene hexachloride) applied to the foliage in emulsified solutions and dusts, and observations on cultural methods of control conducted at Home Hill in northern Queensland during 1946 and 1947 are described. It is concluded that the moth does not carry over from season to season in the Lower Burdekin district, where potatoes are grown under irrigation in the winter, and that this is due to the absence of summer-growing cultivated or native Solanaceae. From this it is inferred that seasonal outbreaks result from introductions with "seed" stocks, which, of necessity, are obtained annually from southern districts. Haulm infestation was effectively controlled by the application of 0·1 per cent. DDT sprays at intervals of up to three weeks, commencing three weeks after germination ; 2 per cent. DDT dusts reduced infestation, but were inferior to sprays. BHC spray had such a pronounced phytotoxic effect on the plant that its use was discontinued long before the termination of the experiment ; when applied regularly, it reduced yields by about 1½ tons per acre. A 4 per cent. dust produced less severe injury, but was not more effective than the DDT dust. Tuber infestation was reduced to 7 per cent. or less by regular applications of 0·1 per cent. DDT foliage sprays, and comparable results were obtained with 2 per cent. DDT dust. It is considered that the application of suitable insecticides to the foliage may serve as a useful adjunct to, rather than a substitute for, late hilling in the control of tuber infestation.

Greaves (T.) & Venables (D. G.). **The insecticidal Control of Cabbage Pests : a Summary of experimental Results, 1944-48.**—*J. Coun. sci. industr. Res. Aust.* **21** no. 3 pp. 171–176, 1 ref. Melbourne, 1948.

Further experiments on the control of cabbage pests by means of insecticides [*cf. R.A.E.*, A **34** 231] were carried out in 1944–48 in fields of cabbage and cauliflower infested by *Plutella maculipennis*, Curt., *Pieris rapae*, L., and *Brevicoryne brassicae*, L., in the Canberra district ; 126 sprays and dusts were tested, and they were applied at rates of 90–100 gals. and 25 lb., respectively, per acre when damage first appeared and subsequently at intervals, usually of a fortnight, until about two weeks before harvest. Detailed results are to be published later, but injury ratings for 13 dusts, 11 sprays and untreated plants for each year are here given in a table. *Plutella* is of greater importance than *Pieris* in the Canberra district, but as the same insecticides are effective against both, the damage due to them is combined as " moth injury ". They destroyed high percentages of untreated plants. It is concluded that DDT is outstanding for their control, BHC (benzene hexachloride) inferior, and HETP (hexaethyl tetraphosphate) poor. No single insecticide effectively controlled both *Plutella* and *Brevicoryne*. To obtain reasonable control of Aphids, the concentration of DDT had to be increased to at least four times that required for caterpillar control. Emulsified solutions of DDT in solvent naphtha controlled Aphids to some extent, but not sufficiently to warrant the omission of a specific aphicide. The most effective dust was one containing 1 per cent. DDT and 2·4 per cent. w/w nicotine (1 pint nicotine sulphate per 20 lb. dust) in an inert diluent applied at fortnightly intervals. A dust containing 0·5 per cent. DDT with 0·125 per cent. γ BHC was also effective, but one containing 1 per cent. DDT with 5 per cent. v/w HETP, freshly mixed, was much less toxic to the Aphid. The most effective spray contained 0·1 per cent. DDT with 0·125 per cent. HETP, freshly mixed ; a spray containing 0·1 per cent. DDT with 1 per cent. w/v soft soap also gave good control at both low and high temperatures. Other effective sprays were 0·05 per cent. DDT with 0·0125 per cent. γ BHC, and 0·1 per cent. DDT with 0·05 per cent. nicotine (1 pint nicotine sulphate per 100 gals.). Combined dusts containing DDT and nicotine sulphate in which lime or other alkaline materials were used as diluent failed to control *Plutella* ; such alkalis react with DDT, greatly impairing its insecticidal qualities. HETP and BHC were not as effective in hot weather against *Brevicoryne* as dusts containing 2·4 per cent. w/w nicotine.

Watson (M. A.). **Some Notes on Plant Virus Diseases in South Australia.**—*J. Aust. Inst. agric. Sci.* **15** no. 2 pp. 76–81, 4 figs., 4 refs. Sydney, 1949.

The results are given of observations on four virus diseases of plants at Adelaide, South Australia, during 1947. A plot of subterranean clover (*Trifolium subterraneum*) was found in October to contain some plants that were dying and others with bright green and yellow mottling on their leaves ; similar mottling was observed on other clovers and on medicks [*Medicago*] in the same garden. The causal virus was subsequently identified as the subterranean-clover virus of Aitken & Grieve [*R.A.E.*, A **32** 90] and was transmitted artificially by abrasion to other varieties of *T. subterraneum*, crimson clover (*T. incarnatum*), garden pea, french bean and white sweet clover (*Melilotus alba*). In all these plants, the symptoms comprised various degrees of mottling, vein clearing and stunting. The virus was transmitted to peas and the two species of *Trifolium* by small batches of *Myzus persicae*, Sulz., and *Macrosiphum solanifolii*, Ashm. (*euphorbiae*, auct.) that were starved for 18 hours before being allowed to feed on infected plants, and more transmissions were obtained when the feeding period on the latter was two minutes than when it was 24 hours, indicating that the virus was of the non-persistent type [*cf.* **35** 204].

A virus disease that caused symptoms similar to, but more severe than, those due to the subterranean-clover virus was found in garden and field crops of peas. It was transmitted by sap inoculation and by means of *Myzus persicae* to garden pea and also to *T. subterraneum* and *T. incarnatum*, in both of which the symptoms were less severe than those due to subterranean-clover virus, but not (by sap inoculation) to french beans. Cross-immunity tests showed that it was not related to the subterranean-clover virus, and it is suggested that it may be a strain of common pea mosaic. The mode of transmission by *M. persicae* indicated that it was also of the non-persistent type.

A virus obtained in August from *Nemesia*, on which it caused distortion and necrosis, produced vein-clearing and chlorosis in *Nicotiana glutinosa* and *Petunia* hybrids, laciniation of the leaves of tomato, and, after a delay of about six weeks, marginal deformities on the leaves of tobacco, to all of which it was transmitted by abrasion. No symptoms developed in french bean, peas or clovers. It was transmitted between tobacco and *N. glutinosa* by *M. persicae*, and was also of the non-persistent type. It is believed to be a strain of cucumber-mosaic virus.

A virus from *Petunia* hybrids was inoculated by rubbing into tobacco and tomato, but was not transmitted by *M. persicae*, *Macrosiphum solanifolii* or *Thrips tabaci*, Lind.

Ryan (F. E.). **Fruit Fly Breeding for experimental Purposes—Apparatus suitable for breeding** *Ceratitis capitata*.—*J. Aust. Inst. agric. Sci.* **15** no. 2 pp. 92–94; 4 figs. Sydney, 1949.

Ceratitis capitata, Wied., has been reared in the laboratory by spreading infested fruits on trays of clean sand, in which the larvae pupate when fully grown, but large quantities of sand are required, mould quickly develops on the fruits which in consequence become set into a mass and may cause heavy mortality, and juice from the rotting fruits cements the sand into clods rendering sieving difficult. An improved method was therefore devised and gave satisfactory results in practice. The infested fruits are placed, without sand, on shallow trays with wire-mesh bottoms, and the trays are stacked one above the other (with spaces for ventilation) in a frame. The juice and full fed larvae fall downwards through the bottoms of the trays on to a pair of sloping and overlapping " drip trays " that direct them to a " splash tray " with a drain for the juice on one side and a tray of sand on the other. The jumping movements of the larvae cause many of them to fall direct from the edge of the lower drip tray on to the sand, and the others make their way to it from the splash tray. They pupate within 24 hours, and can be removed from the sand tray before or after pupation. The juice from some fruits becomes sticky in dry weather, so that the larvae adhere to the trays, but this difficulty can be overcome by moistening the trays daily.

Ludbrook (W. V.). **DDT Spray Injury to Pears.**—*J. Aust. Inst. agric. Sci.* **15** no. 2 pp. 94–95, 1 fig., 2 refs. Sydney, 1949.

In the summer of 1948–49, 30 per cent. of the crop from pear trees of two varieties in a garden at Canberra that had been sprayed with 0·1 per cent. DDT against the codling moth [*Cydia pomonella*, L.] were found at harvest to bear spray injuries. The trees had been sprayed when the fruit was about one quarter, one third and two thirds grown, and the spray was prepared from a commercial emulsion concentrate containing 20 per cent. DDT and was applied in sufficient quantities to cause run-off. The injury, which was confined to the skin of the fruit, comprised slightly depressed rings 1·5–2·5 cm. in diameter, and buff,

brown or brown-black in colour, surrounding a normal zone in the centre of which was a russetted area 3–5 mm. in diameter. This frequently bore a whitish deposit assumed to consist of solid DDT. The rings were on the lowest part of the fruit or at points where it had been in contact with another fruit or with a branch, at all of which excess spray would tend to collect in large drops. Rings of different sizes and intensities of colour sometimes overlapped, and it is thought that the larger and less intense of these resulted from the earlier applications. Since the solid spray residues were confined to the centre of the ring and russetting was most severe round the edge, one or more of the volatile components of the emulsion is thought to have been chiefly responsible for the damage. Two varieties of apple sprayed at the same time were not affected.

HOGAN (T. W.) & MORRIS (D. S.). **Codling Moth and Light-brown Apple Moth—Experiments in Goulburn Valley.**—*J. Dep. Agric. Vict.* **47** pt. 6 pp. 260–264, 3 figs. Melbourne, 1949.

Since the use of DDT against the codling moth [*Cydia pomonella*, L.] on pear in the Goulburn Valley of Victoria has been accompanied by increased infestation by *Tortrix postvittana*, Wlk. [*cf. R.A.E.*, A **37** 26, 78], experiments there in 1948–49 included tests of DDT wettable-powder sprays with and without the addition of lead arsenate against the latter. The percentages of fruits infested by *Tortrix* when two and (in brackets) three applications were made were 13·4 (9·9), 15·7 (10·4) and 9·3 (12) for 0·05, 0·075 and 0·1 per cent. DDT alone, and the corresponding percentages for *Cydia* were 0·2 (0·03), 0·05 (0·01) and 0·15 (0·15). When the same sprays were used with the addition of 3 lb. lead arsenate per 100 gals., the percentages for *Tortrix* were reduced to 0·5 (0·2), 0·8 (0·3) and 0·5 (0·6), those for *Cydia* being 0·16 (0·1), 0·04 (0·01) and 0·03 (0), respectively. The recent increase of *T. postvittana* is attributed not only to resistance to DDT but also to its ability to breed on weeds, so that it can infest pear trees during the long intervals between the sprays of DDT required against the separate broods of *C. pomonella*, when the DDT has lost its toxicity and the fruits are unprotected. Common dock [*Rumex*] was observed to be an important food-plant of *T. postvittana*, and whereas larvae were numerous on dock plants under trees sprayed with DDT, those under trees that received lead arsenate were uninfested. Clean cultivation therefore appears desirable as a means of checking *Tortrix*. A reduction of 40 per cent. in the volume of spray applied per tree, which was achieved by means of special nozzles attached to standard machinery, did not affect the degree of control of either insect and reduced the cost of spraying. No significant infestation by *Bryobia* [*praetiosa*, Koch] and none by red spider [*Tetranychus telarius*, L.] occurred in any of the plots.

In a supplementary test, diethyl paranitrophenyl thiophosphate [parathion], which had previously given excellent control of mites, reduced infestation by *Cydia* and *Tortrix* from 23·4 and 11·9 per cent. in the controls to 2·3 and 4·1 per cent., respectively, when applied twice at a concentration of 0·05 per cent. on 19th October and 26th November ; the corresponding percentages for 0·1 per cent. DDT with 0·3 per cent. lead arsenate were 0·2 and 0·3. The parathion residue on the fruit at harvest was less than one part per million, and this material is considered to show promise as a general purpose spray.

Tests were also made of a turbine sprayer that enables concentrated atomised spray to be applied at a volume of only 14–20 gals. per acre. When it was used with a schedule comprising two applications of 0·5 per cent. DDT, with the addition of 12 lb. lead arsenate per 100 gals. in the second, infestation by *Cydia* and *Tortrix* was 0·12 and 7·44 per cent., respectively, whereas three applications of 0·1 per cent. DDT with 0·3 per cent. lead arsenate made by the

standard spraying equipment resulted in 0·04 and 0·38 per cent., respectively. The turbine sprayer did not give complete coverage.

COMMON (I. F. B.). **The Yellow-winged Locust,** *Gastrimargus musicus* **Fabr., in central Queensland.**—*Qd J. agric. Sci.* **5** no. 4 pp. 153–219, 15 figs., 26 refs. Brisbane, 1948.

An extensive outbreak of *Gastrimargus musicus*, F., occurred in central Queensland during 1939–47 [*R.A.E.*, A **35** 245], and caused widespread damage, especially to pastures. Its course is summarised in an appendix, and a detailed account is given of investigations in 1945–48 on the bionomics and control of the locust. Its immature stages are described. The following is based on the author's summary and conclusions. *G. musicus* is distributed practically throughout coastal and sub-coastal Australia where the annual rainfall exceeds 20 ins. Swarming occurs in the northern half of the continent and migrations into coastal agricultural and dairy-farming districts take place periodically. Coastal infestations originate in localised outbreak areas in the sub-coastal districts; the Clermont-Capella area was apparently the chief source of swarms during the 1939–47 outbreak, which extended inland from Proserpine in the north to Mt. Larcom in the south.

Gregarious and solitary phases of the locust were distinguished. Phase *solitaria* is very variable in colour, with green and dark-brown males and green females predominating. Medium-brown males and dark-brown females predominate in phase *gregaria*. The pronotum is relatively longer, narrower and more convex and the elytron/femur ratio is lower in phase *solitaria*. The degree of sexual dimorphism is greater among the solitary locusts. Non-swarming individuals with intermediate characters belong to phase *transiens*.

Egg-beds are usually situated on relatively bare ground, the concentration of egg-pods in any given egg-bed varying according to the suitability of the soil at oviposition. Cultivated land is sometimes utilised. The number of eggs per egg-pod averaged 39, but apparently shows a marked variation. Embryonic development proceeds only when moisture is available and the temperature exceeds a certain minimum. In the absence of moisture, eggs remained viable for at least ten months. Immersing the eggs in water for up to seven days retarded, but otherwise did not greatly affect, normal hatching. The eggs hatched in about 17 days in the summer. In the laboratory, nymphs of the spring generation required 50–60 days for their development, whereas those of the summer-autumn generation required 44 days. This corresponds approximately to the time required for nymphal development in the field. Aggregations of hopper bands usually occurred in the vicinity of the egg-bed, though band formation did not always follow substantial hatchings. The dense masses of nymphs behaved as single units, the movement of one individual stimulating a similar movement in its neighbours. Their wanderings appeared to be usually without regard to direction and sometimes resulted in the merging of a number of smaller units. Feeding was most marked during the morning, the time of day when it began being influenced chiefly by temperature. Major migrations of adults usually occurred in the autumn and were not undertaken because of food scarcity in the breeding grounds or in search of suitable oviposition sites. Prior to oviposition, the swarm terminated its migration and made only short, circling flights to and from its feeding grounds. Each night the locusts returned to one restricted area, which was used both for roosting and subsequently as the egg-bed site. Mating occurred on the actual egg-bed and frequently a female was attended by one or two males during oviposition. Normally there appeared to be two generations of the gregarious phase each year; eggs of the second generation occasionally hatched in autumn, but in

no observed case did the hoppers reach maturity in bands. The disappearance of these nymphs may have been due either to mortality or, more probably, since adults presumably belonging to phase *transiens* were taken during July, to dispersal.

The eggs of *G. musicus* were parasitised by *Scelio bipartitus*, Kieff. [**34** 2 ; **35** 29, 245], which appears to be specific, the nymphs by a Tachinid of the genus *Tricholyga* and the adults by Sarcophagids of several species. Predators included *Dermestes ater*, Deg., which destroyed the eggs at one place, but may have been accidental, an Asilid of the genus *Bathypogon*, which attacked the young nymphs, a frog (*Limnodynastes peronii*), which destroyed a band of fifth-instar nymphs near a creek, the Sphegid, *Chlorion saevus*, Sm., which preyed on and even controlled some flying swarms of adults, and various birds. Nevertheless, in the coastal portion of the infestation area, at least, parasites and predators appear to be of very limited value.

In experiments on control, poisoned bran baits were more effective against bands of nymphs than dusts of DDT or BHC (benzene hexachloride), which tended to stimulate mass movement away from the dusted area. During spring in central Queensland, where high solar temperatures are associated with low humidity, the efficiency of the standard bait of arsenic pentoxide in bran [**34** 387] appeared to be improved when the water content was increased from 2½ to 3 gals. per 24 lb. dry bran. Bran baits containing enough BHC to give 0·06 per cent. γ isomer seemed to be even more effective. In a test designed to indicate the relative attractiveness of various baits to second-instar nymphs, molasses appeared to be a desirable ingredient of BHC baits, but the arsenic-pentoxide bait was as effective without it. Baits in which the carriers were mixtures of sawdust with bran or flour did not compare favourably with bran baits. The effectiveness of baits varies with climatic factors that affect the feeding of the hoppers and is reduced if many of the hoppers are moulting, since they cease feeding for some hours at each ecdysis.

The food-plants of *G. musicus* are almost entirely graminaceous, and attack on other crops appears to be accidental. Most of the losses caused are due to pasture damage, though local injury to sugar-cane, maize and sorghum is sometimes severe. Outbreak areas need to be carefully mapped so that control may ultimately be preventive in nature. Complete control, once migrations from the outbreak areas have begun, appears to be impracticable, but temporary protection of valuable agricultural crops is possible by the co-operative use of poison bait.

Cox (J. A.). **DDT proves to be effective in Control of Rose Chafer in Erie County Vineyards.**—*Bull. Pa agric. Exp. Sta.* no. 480 (59th Rep. 1945–46) suppl. no. 3 p. 10, 1 fig. State College, Pa., 1947.

The value of DDT and BHC (benzene hexachloride) in controlling adults of *Macrodactylus subspinosus*, F., on vines in Pennsylvania, was tested in 1946 in commercial vineyards in the Erie Grape Belt. This beetle has one generation a year, and the adults feed on the flowers, fruits and leaves of various fruit crops and also attack many ornamental trees and shrubs. They are particularly injurious in vineyards, because they emerge when Concord grapes are coming into bloom. Emergence continues for a week, and they have generally disappeared by mid-July. The eggs are laid in the soil during early July and larvae feed on grass roots and pupate late in the following spring ; the pupal stage lasts two to four weeks. Damage is most severe in vineyards on or near sandy soil, but scattered infestations have also occurred on heavy soils. Preliminary tests in 1944 and 1945 showed that sprays containing ¾ or 1 lb. DDT and 3 U.S. quarts miscible oil per 100 U.S. gals. bordeaux mixture (4 : 4 : 100)

were toxic to the beetles. In 1946, sprays of 2 lb. wettable 50 per cent. DDT powder or 1½ lb. wettable BHC powder containing 7·5 per cent. γ BHC, each with 2 U.S. quarts oil in 100 U.S. gals. in bordeaux mixture were applied on 14th June, approximately six days before the vines flowered. Both sprays were used in one vineyard and the DDT spray only in another. Of a large number of beetles collected subsequently from the first vineyard and caged with unsprayed foliage, 91 per cent. from vines sprayed with DDT and 86 per cent. from those sprayed with BHC were dead after 24 hours. Infestation was heavy in the other vineyard, and beetles were still feeding four days after treatment ; 67 per cent. of those collected then died within 24 hours. A second application of the DDT spray five days after the first gave practically complete mortality. Almost every cluster of grapes in an adjoining neglected vineyard was damaged by the middle of July. On the basis of these tests, treatment with a spray containing 1 lb. actual DDT per 100 U.S. gals., repeated if necessary after five or six days, is recommended.

Hutson (R.), Jones (E. L.) & Benne (E. J.). **Use of DDT in the Control of the Mint Flea Beetle.**—*Quart. Bull. Mich. agric. Exp. Sta.* **29** no. 4 pp. 283–285, 5 refs. East Lansing, Mich., 1947.

Unpublished work by one of the authors (Hutson) has shown that the mint flea-beetle [*Longitarsus waterhousei*, Kutsch.], which is a serious pest of peppermint and spearmint in Michigan [*R.A.E.*, A **15** 94 ; **17** 516], can be controlled by a timely application of a dust containing 3 per cent. DDT at a rate of 40 lb. per acre, but in view of the toxicity of DDT to man, it was considered desirable to determine the amount likely to be present in peppermint oil distilled from treated plants. Substances present in the oil interfered with colorimetric determination of DDT, and the amounts of oil obtained by distillation from the plants on a laboratory scale were too small for conclusive tests by Gunther's dehydrohalogenation method, but when duplicate samples of the oil obtained from a plot of plants that had been dusted with DDT at the recommended rate about three weeks before distillation were analysed by three investigators using Gunther's method, two found no DDT in either sample, though the third found a trace in both. In tests in which 5 gm. technical DDT was steam distilled alone or with 20 ml. peppermint oil for 30 minutes in the laboratory, the distilled oil contained 0·52 per cent. DDT and the aqueous distillate from the DDT alone contained 0·95 per cent. It is estimated from these data that the amount of DDT in the total yield of oil from an acre of treated plants is likely to be only 0·003 lb. (possibly 75 parts DDT per million parts oil by weight), so that the amounts present in materials flavoured with peppermint oil are likely to be extremely small.

Papers noticed by Title only.

Schedl (K. E.). **Nachtrag zur Gesamtliteratur der Borkenkäfer (Ipidae und Platypodidae) von R. Kleine 1939.** [Supplement to the Bibliography of the Bark-beetles (Scolytidae and Platypodidae) by R. Kleine, 1939 (*cf. R.A.E.*, A **36** 72).]—*Zbl. GesGeb. Ent.* **1** pt. 1 p. 32 ; pt. 2 pp. 63–64 ; pt. 3 p. 96 ; pt. 4 pp. 123–128 ; pt. 5–6 pp. 185–190. Lienz, 1946. *Op. cit.* **2** pt. 1 pp. 63–64. 1947. *Op. cit.* **3** pp. 63–105. 1949.

Jamalainen (E. A.) & Kanervo (V.). **Hedelmäpuiden ja marjapensaiden ruiskutusopas.** [The Spraying of Fruit Trees and Berry Bushes (against pests and fungus diseases in Finland).]—*Maatalouss. Keskusl. Julk.* no. 254 (3rd edn.) 61 pp., 62 figs. Helsinki, 1948. [*Cf. R.A.E.*, A **25** 664.]

BRITISH STANDARDS INSTITUTION

A Committee for Nomenclature of Pest Control Products

During the last twenty-five years, great advances have been made in the development of chemicals for pest, disease, weed and rodent control. In the past ten years in particular, many new compounds have been marketed on a world-wide scale for use in the medical, veterinary, agricultural and industrial fields. The chemical names of these compounds have in many instances been too complicated for common use, and shortened forms and trade names have been devised. As there may be several of these applied to one chemical compound, confusion has arisen in commercial descriptions of products and also in the scientific literature.

The problem was discussed at the Commonwealth Entomological Conference in 1948, and a resolution passed urging the appointment of a committee to agree common names for established compounds. The Executive Council of the Commonwealth Agricultural Bureaux referred the recommendation to the British Standards Institution, as the appropriate body in the United Kingdom to deal with the matter. A Technical Committee for Nomenclature of Pest Control Products has now been appointed by the B.S.I. and includes representatives of Commonwealth countries, Government departments, scientific societies and manufacturers' organizations. The Committee meets under the Chairmanship of Mr. H. J. Jones, A.R.I.C., who is also Chairman of the Pest Control Products Industry Standards Committee of the Institution, with Dr. Catherine Tinker, A.R.I.C., as Secretary.

The Committee's terms of reference are: "To prepare standards for the nomenclature for insecticidal and fungicidal chemicals and other pest control products." It is working in the closest collaboration with the Standards organizations in Commonwealth countries, and with the Inter-Departmental Committee on Pest Control in the United States of America. Standards organizations in other countries have been informed of the formation of the Committee and of its proposed programme, and it is hoped that it may eventually be possible to arrive at international agreement on nomenclature.

CK (PCC) 9123: *3rd February*, 1950.

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